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THE SALE OF TANDING TREES.

Having read the article on the above subject in your September issue I think that a note on the methods of sale of standing trees adopted in the Federated Malay States may not be without interest. It is just 30 years since forest conservancy and organization were taken in hand in this country and our experience in disposal of standing trees lies chiefly in mangrove forests. These forests are the chief source of supply of fuel to the tin mines and towns which are within economic transport distance of the coast. The area available annually is about 3,000 acres and this is divided into felling areas of from 100 to 200 acres each which are supposed to be exploited within one year. In actual practice they are seldom finished in less than eighteen months and they frequently last as much as two years. The problem is to dispose of these felling areas to the greatest advantage to the State with the least inconvenience to the contractors and to the public which depends on them. Our experience appears to have been very much the same as that of foresters in the United Provinces as described by Mr. Channer. Before and for a short time after the Forest Department was founded in these States the mangrove forests were exploited by the simple means of issuing to the firewood contractor a monthly permit for every man he employed without limit to numbers, and with very wide limits as to area. In those days owing to the lack of transport facilities the demands on the forest were far less than the potential out-turn and consequently little harm was done. This crude system was replaced by the

royalty system and at the same time a limit was put on the area to be opened yearly. The fixing of the rates of royalty gave no trouble for some years, possibly because the rates were too low. Royalty was not collected in cash at stations on the lines of extraction. The out-turn was checked and removal passes were issued at the stations, duplicate removal passes being sent in weekly to the district forest office where they were entered in the contractor's account. Accounts were settled monthly. Before beginning work the contractor was required to make a cash deposit equivalent to about two months' royalty. The difficulty that arose was the allotment of the areas among the contractors. By way of avoiding this difficulty we then tried what Mr. Channer refers to as the lump sum system, with exactly the same results. The only apparent difference, and it is a small one only in our procedure from that of the United Provinces, was that we sold the areas by tender instead of by auction. From a revenue point of view this system was satisfactory enough and it had the financial advantage that it did away with the necessity of a costly system of checking the out-turn as it came from the forest. Out-turn figures were, however, a matter of considerable importance to those who were trying to evolve a satisfactory system of management with but little exact knowledge to build on. An objection which appeared was that the tenders were too much in the nature of a gamble. The contractors were and are all Chinese. They had their labour forces on the ground and their coolies were always indebted to them, often to the extent of several thousands of dollars. (One dollar = 2*s.* 4*d.*) It was, therefore, necessary for them to make sure of having forest to work in order that they might not lose their labour and break up their organizations. Their estimates of the possible out-turn were guess work, but they were probably not far wrong. The Forest Department could not supply estimates of out-turn. Anyone having experience of work in mangrove swamps will appreciate the difficulty and expense of exact stock taking in such forests. The lump sum system undoubtedly tends to encourage complete exploitation but the same object is achieved under the royalty system by dividing each coupe into three or four blocks

and making it a condition of the agreement that not more than one or sometimes two blocks may be worked at one time without the permission of the divisional forest officer. This permission is only given when all wood over eight inches in girth has been removed, with the exception of trees retained for purposes of regeneration. The result of this regulation has been that the average out-turn per acre has been raised from 30 tons to over 70 tons, to the benefit of Government revenue, the contractor and the consumer. As in the United Provinces the next step was a compromise between the royalty and the lump sum systems. Royalty was fixed at a certain rate and the areas were disposed of by tender. This is Mr. Channer's "Monopoly and Royalty System." It gives the Government an assured return and admits of differentiation in the payments for the areas in accordance with their values. There are very considerable differences in the values of felling areas. The forest is not uniform and costs of extraction and transport vary greatly according to the distance from the market and the extent to which it is served by waterways, all transport being by boat. In practice it is found that under the "Monopoly and Royalty" system revenue per ton is slightly less than it was under the royalty only system. It is sometimes desirable to allot a coupe without competition. For instance there is, within eight miles of the forest and connected by railway with the port to which the wood is brought, a group of tin mines which consume monthly five or six thousand tons of mangrove fuel. These miners having formed a co-operative firewood supply association an area is allotted to them annually, the premium being assessed on the price paid for similar areas by contractors. Royalty is of course paid in addition to premium. It also sometimes happens that a well-known contractor is in danger of being short of the forest necessary to carry on his business. In such a case he would be allotted an area on the same basis.

During the great war and for a short time after it, an entirely different system was adopted. The cost of and the difficulties in procuring coal put the firewood cutters in a very strong position and they did not hesitate in trying to make the

most of it. Having the main source of supply in their hands they forced the price of firewood up 80 per cent. and it would no doubt have gone still higher if the Government had not intervened. The action of the contractors was unwise and it demonstrates the folly of opening one's mouth too wide. With the approval of the Government the Forest Department took over the whole-sale trade. Felling areas were disposed of by tender, the contractor being bound by his agreement to sell the whole of his out-turn to the Government at the rate specified in his tender. The Forest Department disposed of the wood to consumers at a rate designed only to cover the cost of the organization plus royalty, and this proved to be some 30 per cent. less than the profiteering price of the contractors. This business was dropped as soon as circumstances allowed the trade to be carried on under normal conditions. Whatever system is adopted the difficulty that always crops up is that of allotting felling areas without such competition as will tend to put up the price of wood to the public. A means of accomplishing this which has in certain circumstances proved satisfactory is that of drawing lots for the areas. This unorthodox method may shock the strict economist, and no reference to it will be found in Schlich. Nevertheless it has been adopted without disaster at times when the areas for disposal were all more or less of equal value and there were enough of them for all contractors to get at least one. It was certainly popular among the Chinese contractors who, like the most of their race, are generally ready to leave something to luck. At the present time an attempt is being made to fix a scale of premiums for areas based on their estimated out-turn value and their positions as regards extraction and transport. Neither quality admits of exact valuation, but when once the values are fixed and published, resort will again be had to "the draw" and the contractor whose Joss is pleased with him will no doubt see that he gets a coupe that has been undervalued.

Under the conditions prevailing in mangrove forests a guaranteed minimum out-turn would be impossible owing to the difficulty of checking the out-turn from each felling area, many of which are close together. It is easy to check the total out-

turn and also to trace the quantity derived from each coupe so long as it is all paid for at the same rate, but if rebates were given for shortage in out-turn we should find that many coupes would be short of the minimum, while one or two would greatly exceed it. All communications being by water control is not easy.

Whatever systems of disposal are adopted in the future in this country or elsewhere, the two essential points are that the State should get its fair share of the profits, and that the price of the out-turn to the public should be reasonable and as stable as possible. Continual changes in method cause uncertainty in the outlook of the contractor which is good neither for him nor for the public which he serves.

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ELEPHANTS AND THEIR CARE.

The Forest Department maintains many elephants and some vets; the private owner also maintains many elephants, but no vets. The forest elephants are always ailing or dying; private elephants seldom. The logician would condemn it as a fallacy if we were to conclude that the vets are the cause of disease and death; so we have to seek for other causes. I venture to note below some of the impressions that I have formed on the subject, not, it should be understood, with the pompous authority of an expert, but with all the diffidence of a layman whose only conceit is that all these eight years of his service have been spent almost wholly in elephant districts. It should also be understood that I write this neither to advertise this conceit, nor to discredit anybody, but simply to set forest officers a-thinking on a subject which is of some importance to them, and has of late, begun to cause them increasing anxiety.

It might at the outset be profitable to institute a comparison between the life of a forest and a private elephant. The biggest private elephant gets 30 *edangalies* (70 lbs.) of rice a day; while the biggest forest elephant has to fatten himself on 20 *edangalies*

(44 lbs.) of gram and *ragi* and the dignity of belonging to the Sirkar. The private elephant gets a longer period of rest in the year, and rich food and tonics during the rest ; while the forest elephant like the forest officer, gets very little even of that great tonic in itself, rest. The private elephant is invariably stall-fed during the period of rest, and also while working if there is shortage of fodder in the neighbourhood of the camp. The forest elephant has always to find its own fodder. The private elephant gets a more thorough scrubbing and massage and a longer bath than the forest elephant who has to hurry through his bath, for he must not miss his roll call at any cost even though he had hobbled a long way from camp the previous night in search of food. A private elephant gets three or four attendants (to ensure the thorough scrubbing and to collect the cut fodder) ; while the biggest forest elephant gets but two. The private elephant drags by means of a rope gripped between his teeth ; while the forest elephant works glorified in a harness and drags by the region of his body which one could best describe only as the angle of the neck and fore-legs. The private elephant could drag logs much heavier than what the forest elephant could. Incidentally, we have nice charts exhibiting the working capacity of our animals worked out by an ingenious formula based on their heights. How I wish a similar formula were devised for forest officers also ! I should certainly benefit most thereby. Finally, as I began, the forest elephants are always ailing and dying to the chagrin of our vets and the exasperation of our officers; while the private elephants flourish hale and hearty.

The elephant's food.—The elephant is a tremendous eater; indeed, he is a glutton. The divine elephant who is the son of Siva begotten of the fair daughter of the Himalayas, eats a thousand cocoanuts, a thousand bunches of plantains, several maunds of beaten rice, puffed rice and cooked rice, and large quantities of other delicacies such as sugar-candy, jaggery, etc., for one meal. Mortal elephants have of course to be content with much simpler fare ; but they don't mind a bit as long as they get plenty of it. The horse chews his food to a fine pulp while

he is eating; the cow does the same at leisure after she has eaten. The elephant can't do either, for his chewing apparatus is designed only to break and crush. So he just breaks and crushes his mouthful and throws it down his throat as fast as he can, taking in, it would seem, a substantial safety factor to allow for any morsels that might escape digestion.

In his natural state he is eating all the time that he is not sleeping. We cannot, of course, allow that; for, we keep him for work. That being so, it is quite safe to postulate, even for a layman, that we must give him artificial food enough to compensate for all the fodder that he would have consumed had he been eating all the time that he had been working—nay even more, for we did not consider the extra energy expended in dragging our timber. What should this artificial food be? It may be anything that a mortal elephant eats, but in a condensed form; for his eating hours have been considerably reduced and he cannot therefore tackle large quantities. We may give paddy, rice, gram, ragi, wheat, peas, or any such thing. We don't usually give paddy (though some people do give it, boiled) because loose paddy is difficult to give and difficult to eat for an animal like the elephant, and much is therefore wasted. So we husk it, and then cook the rice because it is softened thereby and we could mix and roll it into convenient balls for us to give and the elephant to take. There is no waste, besides, either in the elephant's stomach or outside. If we powder the rice into flour and give it as dough or mixed with water sufficiently thin for it to suck the liquid by the trunk, it would do quite as well. Cooking is not in the least necessary; we do it only because it is the easiest way to treat this grain for our purpose. Similarly we treat the other grains also, the mode of treatment depending upon the nature of the grain: gram is cooked and pounded into a paste; ragi being a minute grain is first powdered and then cooked into a paste. The cooking is done in all these cases, it is worth while emphasising again, not because the elephant cannot digest these grains raw but because that is the most convenient way of reducing them to a form in which they could be easily served and swallowed with the minimum waste. If he gets access to the crop an elephant eats all these grains raw, stem

leaves, ears or pods and all. But then he does not get the grains loose, but mixed and rolled with the remaining parts of the plant and so gets a much better chance of catching the grains and crushing them between his teeth. Even so, an examination of the dung will show that some grains escape crushing and pass through whole. It often happens that our elephants stray into paddy flats and help themselves to a sumptuous feast in the dead of night. It is always the Forest Department that suffers in consequence and not the elephants, even in spite of the fact that several grains of paddy having escaped their teeth are passed out undigested. To sum up therefore, the artificial food may be anything that the elephant naturally eats provided it is reduced to a certain convenient form : it may be Kulu apples if we could afford them or mere ragi or gram—black or brown or red—or rice—raw or boiled or table or cooly. It is not quality that matters but quantity.

As regards quantity the points to be considered are :—(1) The food value of the diet; (2) the quantity of work that the animal does; (3) the quantity of fodder available after working hours; and (4) the natural propensity of the animal for gluttony. We give ragi and gram here, and they are all right as regards their food value. Let us leave it to the experts to assess the quantity of work done in terms of the energy lost in doing it; while let us content ourselves to argue from results. That will be, to say that our elephants are in poorer condition than the private elephants and to suspect, if not to conclude, that the food that we give is insufficient. As regards the fodder it is well known that our work is much more concentrated than the private merchant's, and, therefore, we have to employ more elephants at a place than the private owner need, so that the fodder in the neighbourhood of the coupe gets sooner exhausted. This evil is at its worst in a place like Nilambur where the work is most concentrated and is confined to the teak plantations, which are very poor in any elephant fodder. In the circumstances our elephants do not get sufficient natural fodder. It is obvious that we should therefore give them more artificial food and cut fodder. But we don't give them any cut fodder, and not even as much artificial food as the

private owner gives to his elephants which work on scattered fellings in natural forests, a few animals only in a camp, and the camps far apart. The gluttonous nature of the animal has also to be considered. A glutton cannot be contented with a small quantity of anything, however concentrated and rich in food value it may be. He must have his fill or he feels starved. Now, if we do not feed him sufficiently and let him feel starved, it is quite natural that he would to allay his hunger eat anything that he can get at, good, bad or indifferent. Starvation is a great leveller of qualities. So our elephants eat any dirt that will fill their stomach, including barks of trees. Anyone walking through the teak plantations could not have failed to notice hundreds of trees barked. Who by ?—by our elephants: and what for ?—to eat. We may walk through miles and miles of natural forests, but we will not see this phenomenon. The elephant is not a bark eater by nature: he eats leaves, grass and succulent stems and fruits.

Laymen should dread to tread where experts could rush in but even a layman, I think, may safely venture to say that if an animal eats food which it is not by nature fitted to eat, it will surely get ill. It is my impression that half the ills that our elephants suffer from are due to lack of good food and consequent eating of bad food.

The elephant's bath.—Living in a state of nature the elephant employs two agents for its ablutions—mud and water. Sprinkling mud on one's body is a very dirty habit which we must not countenance. The objection, however, does not hold for water; so let us give him as thorough a plunge and scrubbing and massage in the stream as we could. Somehow or other this seems to be the best all-round tonic for an elephant—at any rate in captivity. The private owner is very particular on this; and we must take it that he really knows something about elephants, for he manages to keep his animals in good condition and to take longer years of service out of them. It must not be supposed that he has only a smaller number to take care of, and therefore could take care of them better. One merchant alone here owns as many as forty elephants. During the last ten years he has lost only two animals; one a calf which died of some malady and the other a grown up

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one which was killed by a wild elephant. To return to the bath it is quite a common sight of a morning or an evening, if one takes a stroll to the stream near a private elephant camp, to see two and sometimes three men toiling on an elephant lying in the stream trying for all they are worth to rub his skin off with pieces of dry cocoanut husks cut across the grain, or sometimes even with smooth boulders. The elephant rises with a whole skin, of course, when they have done with him; but he got a thorough massage and feels all the better for it. Boulders are always used instead of the husk on weak and anæmic animals. The forest elephants are too tender skinned for the boulder; they are not bathed for the massage but for toilet purposes; and a piece of cocoanut husk and one valet per head could surely make them as respectable as elephants need be. Soap and sponge will be ideal of course, but rather costly, and so let it be the coir.

Dragging by teeth versus *dragging by harness.*—The private elephant drags by his teeth. A rope of fresh fibre (soaked and softened in water if not quite fresh), thick at one end and thin at the other is used. The thin end is tied to the log through the drag-hole, and the thick end given to the elephant who grips it between his teeth and drags the log. The advantages of the method are that the elephant gets as good a grip on the load as possible; could give it a lifting motion at the near end with his neck; and use his fore-legs and trunk to strengthen or secure his grip when need be. He is not cramped but gets a good deal of freedom of action, and could heave or pull or turn with ease. The system, however, has one great disadvantage, that it spoils the teeth and disfigures the jaw. This, of course, is glaringly cruel and shocking to civilised man whose taste lies in subtle tortures.

The forest elephant drags by a cumbersome harness tied in a cumbersome way to his cumbersome body. This harness is made on the same principle as that of the horse, collar, saddle, tailband, and all. It is true that the elephant is not made on the same principle as the horse; but that is only a minor point for which after all the elephant is himself to blame. The load is dragged by a long chain, which starting from the collar on one side passes through a ring hung from the saddle, thence through the draghole

or round the end of the log, and back round to the collar again through the saddle ring on the other side. The only defect of this very ingenious contrivance is that it does not help the elephant in the least. It is an exclusively dragging apparatus; while the elephant is not a dragging animal. He has neither a hump on his back or shoulders, nor a pronounced breast nor any other physiological contrivance to drag a load tied to his body. And, if he needs must drag a load for man, he must, like man, get a direct grip on it. With the harness he does not get such a grip and wreathes and struggles before he could move the load. When once the inertia of rest is overcome the law of motion gives him some ease until the load hits an obstacle, when he is done for. He cannot lift or turn it or otherwise dodge the obstacle, but must pull and pull till he breaks through the obstacle or breaks the chain or his mahout's stick. The result is that he strains himself and gets tired soon, cannot drag heavy logs, nor drag the lighter logs a long distance. A huge *poon* log, from up the Ghats, such as were much in demand during the war, is, for example, beyond the capacity of our best elephants, working with the harness. Many such logs were worked by private merchants here, from forests which we would have called "inaccessible," and sold at fancy prices. We have as good elephants, and better trees in our forests; but our elephants only toil and die while our trees grow and rot.

The harness certainly has a great virtue that it does not injure the teeth nor disfigure the jaw. But are we quite sure that to save the teeth and the jaw we are not sacrificing things more vital, the heart and the nerves? I wonder; let the experts answer. "One thing, however, is certain; all the rest may be lies;" that private working elephants live longer than our working elephants. Gorden, Maharajan, Moideenkhan, Jupiter, and several others, all magnificent animals and willing workers are in their graves, despite the harness and the vets.

Diseases.—Elephants suffer from many diseases. Of them diarrhœa is the most common and frequent. This may be directly caused by the animals themselves by eating mud to purge themselves of worms of which they often suffer. We cannot pre-

vent this altogether unless we could control and sterilise all the natural fodder that they eat ; but we could minimise the frequency and severity of the attacks by occasional doses of purgative with worm powder or some such thing. Diarrhœa may also be caused as has been suggested above by insufficient food and fodder, and consequent eating of barks and other unwholesome things. This could be prevented. All this, of course is what the layman thinks. There are some learned Pundits who think otherwise. They argue somewhat thus :—" Diarrhœa is caused by bad food." Well, any fool can say that ; the question is which is the bad food ? Of all created animals only man is stupid enough not to know what is bad for him. So it cannot be the natural fodder that the elephant ate. Besides, how is one to know what all rubbish the wretched animal had sneaked into its stomach. And, moreover, it is bad policy to blame the animal. So it must be the artificial food. Again, which could it be ? Rice, ragi or gram ? Let us examine the dung. Can't see any rice or ragi, but—ah ! here is a grain of gram, and it is Ethiopian black too ! But the rice was boiled soft, and the ragi powdered and boiled and so they could not be recognised. That is a point, no doubt, but then we must trace the blame to something, and here is a murderous looking grain of gram which anyone could see without even a pair of specs. True he, too, would have baffled detection had he been crushed and mixed like his companions ; but that is neither here nor there. There he is anyway and he looks quite villainous. Well then, say it is the gram, say it boldly and be done with it.

Few, few shall live if at this rate

The vet does guide our el'phant's fate

And blindly to the gram it ate

Assigns the cause of all its ills.

Apologies of course to the poet.

Dropsy and debility are also common ailments. It is the new captures that suffer mostly from dropsy, and the most willing and hard workers from debility.

Mortality.—The elephants that die may be put under two classes, the new captures and the working animals. The shock of the fall, injuries received during capture and training, self-inflicted injuries in their endeavour to escape, the cramped life and monotonous food in the kraal, all contribute to lessen the vitality of the new captures and bring on disease. It is nothing surprising therefore, that some of them take ill and die. Most often death takes place within the year of capture; while very seldom the animals drag on ailing for another year or more. Once they survive the crisis, however, there is no reason why they should die in a hurry. At any rate private elephants live and work for a long time. But ours unfortunately work and die soon. Very often they die suddenly; and then the vet says "Anthrax" or "suspected anthrax" and dismisses the subject. Only one or two words, no argument, and no postmortem. True the bacteriologist disproves the diagnosis later; but then the elephant is in its grave, and it does not matter. Sometimes prolonged ailment precedes death. Then the vet says bots or other parasites, anæmia, debility, etc., etc., and drugs the animals accordingly. The doses of the drugs, by the way, depend on the tastes and fancies of individual vets, for they do not seem to have come to an understanding yet on this important matter—not even in the case of an inocculation for anthrax. He also tries to prevent these diseases by tabooing gram of all sorts, not to mention the venemous black-skinned variety, pickling the dung in brine or decomposing it with lime and various other highly practical and ingenious ways. Still the elephants refuse to keep fit or cease dying. Small wonder, the layman thinks—in his ignorance of course—and ventures to suggest that the primary causes at work may probably be insufficient massage, insufficient food, and the irrational harness. The first two causes reduced vitality and resistance to disease; while the harness probably strains the heart and the nerves too much. Indeed the sudden deaths may be due to heart failure, for aught we know.

I must in conclusiou admit that I have made this article rather controversial. But hard words break no bones; while they may sometimes provoke furious thought; and that is my

aim. There is something rotten in the state of Denmark, and the sooner we get to know what it is the better.

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SUCCESSIVE MEASUREMENTS OF SAMPLE PLOTS.

A high degree of accuracy, which to the practical forester must in the majority of cases be merely of academic interest, is a *sine qua non* for all sample plot measurements. Most delicate and elaborate methods with varying claims to accuracy have been therefore advanced from time to time to eliminate the errors involved in sample plot measurements. In these Provinces, however, we follow the *Dehra Method** which claims to achieve a high degree of accuracy by means of a simple device which consists in replacing the less elaborate though by no means less accurate Volume Curve by form factor and height curves. Since, however, some special features of the Dehra Method could be refuted, it will serve our purpose best if we deal here merely with such points as are vital to our discussion. Speaking generally, we may say that the volume of a sample plot ascertained by adopting the Dehra Method involves an error of the order of ± 3 per cent. when compared with the tree volume of a plot obtained by felling and measuring every tree on it. This error may increase to ± 5 per cent. in the hands of untrained workers.

Having recognised the fact that the Dehra Method which we adopt in our work involves appreciable errors however small, we may now examine the nature and the purpose of the remeasurement of sample plots at given intervals. Amongst the various reasons which necessitate the remeasurement of sample plots, perhaps the most important reason is to collect statistical data for the calculation of 'increment.' The accurate determination of the volume increment forms the basis of all scientific investigations, and the chief aim, therefore, of all periodic measurements.

* The method has been borrowed from the Prussian Institute, Eberswalde. It was proposed by Dr. Schwappach as early as 1891.

The increments per cent. (p) is usually obtained from the formula—

$$p = \left[\frac{V_2^{\frac{1}{n}}}{V^{\frac{1}{1}}} - 1 \right] . 100$$

Where V_1 and V_2 are the volumes of a plot measured at an interval of n years. Now if errors of δV_1 and δV_2 have been made in the initial and final volume measurements respectively then the corresponding error δp in the increment per cent. is given by the formula—

$$\frac{\delta p}{p} = \left(1 + \frac{100}{p}\right) \frac{1}{n} : \left(\frac{\delta V_2}{V_2} - \frac{\delta V_1}{V_1}\right).$$

Assuming a limiting error of $\pm$ 5 per cent. in the initial and the final volumes of a plot measured at the interval of 10 years the corresponding error in the increment per cent. can be calculated from the above formula as an illustration. For an increment per cent equal to 2, the percentage error involved in it, corresponding to varying directions and magnitudes of the errors in the initial and the final volume, will be found in the following table:—

Percentage error in V_2.	Percentage error in $V_1 = +5$.	Percentage error in $V_1 = -5$.
	Percentage error in p.	Percentage error in p.
+5	0	+51·0
+4	− 5·1	+45·9
+3	−10·2	+40·8
+2	−15·3	+35·7
+1	−20·4	+30·6
0	−25·5	+25·5
−1	−30·6	+20·4
−2	−35·7	+15·3
−3	−40·8	+10·2
−4	−45·9	+ 5·1
−5	−51·0	0

It will be noticed that once an error is made in the initial measurement V_1, not even the maximum accuracy in V_2 can reduce the error in p. For instance, if an error of $\pm$ 5 per cent. has been introduced in V_1, then the error in the increment per cent. would be $\mp$ 25·5 per cent, although the percentage error in the measurement of V_2 be nil. The error in the increment per cent. is zero when the errors in the initial and the final volume agree both in direction and in magnitude.

From the formula given above it will be apparent that the error in the increment per cent. is inversely proportional to the number of years (n) which elapse between two measurements Thus, *ceteris paribus* a five year period will introduce twice as much error in the increment per cent. as a ten year period. It also follows that the period of remeasurement when once fixed may not be changed if consistent results are to be aimed at, since the error in the increment per cent. is an inverse function of the period and not an independent one. It is, therefore, advisable to keep the period as high as is consistent with purpose of the experiment and when more than one remeasurements are to be done the same period should be adhered to. In this connection I may take the liberty to suggest a ten-year period instead of a five year period as recommended by the Dehra Institute since it coincides with the period of the usual thinnings as also with the interval at which the volumes and other statistical information are shown in the tables. Apart, however, from the consideration of the errors involved in the increment per cent the interval between successive measurements should be kept constant since it coincides with the period at which sample plots are thinned. The thinning period obviously could not be changed at random without disturbing the conditions under which trees grow in a sample plot.

A reference to the table given above will show that when the same errors both in respect of magnitude and direction are made in the successive measurements the error in the increment per cent. is nil. Thus, if the volume measurements are carried out by a method which can be relied upon to give a constant and systematic error it matters little what the magnitude of this

error may be. But unfortunately there is no known method which satisfies these conditions. It becomes important then, to keep these errors as low as possible in magnitude since no manner of control can be exercised on their direction.

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EXTRACTS.

FOREST PRODUCTS RESEARCH.

Extract from the Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1924-25, published by His Majesty's Stationery Office, 1925.

The preliminary survey by the Forest Products Research Board of the field of research was completed by the visit last summer, as explained in the last report, of two technical officers to Canada and the United States to make an intensive study of the organisation and methods of research in forest products obtaining in these countries. As a result of the Board's

preliminary survey, plans have been developed for the erection of a Forest Products Research Laboratory on the site acquired for the Department at Princes Risborough, and it is expected that building will be begun in the autumn of 1925. Since, however, a period of two years must be allowed for the completion of the first stages of the Laboratory, approval has been given to *ad interim* arrangements, which are now being carried out, for the immediate organisation of the technical sections eventually to be housed at Princes Risborough. The Department has appointed a full-time Director of Research, Mr. R. S. Pearson, C.I.E., lately Forest Economist to the Government of India, who is now engaged in this duty. In the interim period, the bulk of the work, which includes timber mechanics and wood preservation, will be carried on at the already existing laboratory for research in seasoning, within the Royal Aircraft Establishment, South Farnborough, Hampshire.

As a close to the preliminary period of survey, bulletins are being prepared for issue summarising existing information on structure of wood, decay of timber, air-seasoning, kiln-drying, and preservation.

An important piece of research is in progress in relation to the cause of brittleness in timber, with special reference to aircraft spruce, and interesting results have already been obtained. Plans are also in progress for an investigation into the mechanical properties of home-grown timbers, with, in the first instance special reference to the utilisation, as pit-wood, of thinnings from the plantations of the Forestry Commission. A third important matter arising out of the preliminary survey is the question of preservation. The result of an expert enquiry carried out by Department indicates that there is room for considerable improvement in methods of creosoting as practised in this country. The Director of Research is now in consultation with the British Engineering Standards Association with the object of formulating tentative standards of treatment, and it has been decided to set up an experimental plant to prove or impove their efficiency. The proposals for this work also embrace much-needed research

into preservatives other than creosote, with special reference to the preservation of timber in houses.

A start has been made in co-operation with industry in the improvement of kiln-drying practice: with the advent of the further staff required, this work should bear fruitful results.

The work on the chemistry of timbers, though carried out by only one worker, has produced results now in process of development, which bid fair to realise at least one important industrial result.

PUTTING PEP IN PROPAGANDA.

What does the average Australian read in his daily newspaper—apart from racing news? He reads what the rest of the world reads—articles with snappy titles—and, unless he happens to be marooned on a desert island, or left with time to kill at a bush railway siding, he gets no further. Consciously and subsconciously he dodges the solid, well-meaning, and frequently lucid articles written on more or less technical lines. Why? Because they have not the proper bait to hook him, in other words, their headlines or "captions" do not arrest the eye.

Take an article by an eminent specialist entitled "The Glucoside Principle in Carbons and Hydro-Carbons." Smothered under this weird label there is an admirably lucid article which proves conclusively that the things one really ought to eat are carbons, hydro-carbons, peptones and monkey glands. Certainly it might be improved by a system of cross references with "Mrs. Beeton's Cookery Book," showing whether the ingredients should be served as a hash, sweetened to taste or eaten to music. Again it might be pointed out that stewed peptones can be greatly improved by a dash of caper sauce, or that monkey glands can be underdone or overdone. The real fault, however, lies in the title. It is too highbrow for the average citizen, and he doesn't read the article because he neither knows nor cares how many glucosides go to the peptone or, *vice versa*, and he wouldn't know a hydro-carbon if he saw one.

The result may be tragic. Our average citizen peacefully pursues the even tenor of his way, blissfully ignorant of the fact that a simple diet of chutney and hard-boiled eggs is deadly poison. Through his fondness for pickles and pork pies, he is slowly but surely adding layer after layer of tannin to his long suffering stomach. What agonies of indigestion, gout, or diabetes might have been saved if the glucoside specialist had climbed down from his empyrean heights and simply labelled his article "A Substitute for Sausages!"

It may be argued with perfect truth that the man in the street is happier through not knowing that a mutton chop, even without mustard, is deadly, or that his pot of beer teems with bacteria. Further, it is an indisputable fact that perfectly useful lives have been led by men who never knew the danger of treading on, or simply colliding with, an atom. All this and much more can be admitted, but for a man to go through life without knowing that "from the cradle to the grave we are surrounded by wood" is pure tragedy. And yet it can be said of thousands in Australia to-day.

"A orkey nut by the river's brim
A bloomin' orkey nut was to 'im.
And it was nothing more."

There is one way, and one way only, of lifting this veil of ignorance, and that is by a campaign of forestry propaganda on modern up-to-date lines. The key to success is the slogan "Hectic Headlines."

Forestry at first sight does not appear to lend itself to arresting headlines, and there is the danger of cheap publicity. One cannot, of course, take the same liberties with forests as one can with "Hutton's Hams," for example. At the same time, stunt advertising on modified lines has been adopted with marked success in the Forest Services of America and Canada. The tempting bait is half the battle. Once a man is hooked, he can be fed on good solid silvicultural food.

Likely headlines can be given in illustration of this point, *e.g.*, "Cocoanut Conservation in Cocos Island" (a cocoanut is always a tempting bait), "Serious Slump in Softwood Supplies"

"Facing the Fury of the Fire Fiend." Public interest might be stimulated in the problem of insect damage by such a title as "Baby Trees Blighted by Bugs," where "The Life History of Tomicus Chalcographus" leaves everyone stone cold. It is impossible to work up any enthusiasm over a creature christened with such an appalling name. One might forgive the "Tomicus" and even get to like it, but never the "Chalcographus." Again the headline "Kino as a Source of Kinetic Energy" might stimulate interest in the enormous value of our neglected by-products, and possibly awaken in someone the first faint stirrings of a forest conscience. Examples could be multiplied *ad infinitum*.

It may be pointed out that some of the headlines suggested are not legitimate. "Kino," you say, "is not a source of kinetic energy"—everyone knows that. The question is—"Does *everyone*, apart from cross-word puzzle artists, know the meaning of "kinetic?" Many people would immediately jump to the conclusion that it had something to do with wireless, and be enormously interested. The object in any case is to let the man in the street know what kino is—*not* kinetic energy. If he knew that he might go tampering with an atom, "Kinetic" is the bait, and the hooking is the thing.

If these specious arguments are not accepted, we can at least ease our consciences by reflecting on that epic remark of Dr. Johnson "Man is not on oath in lapidary inscriptions." If a man can write anything he likes on tombstones, he can tell any lie he likes in advertising propaganda. One has only to look at any well-known "advert." to realise that he not only can, but *does* it.—[*Australian Forestry Journal, September* 1925.]

THE MANGROVE FORESTS OF THE BHUKET CIRCLE, SIAM.

Siam is fortunate in possessing a great wealth of mangrove forests along the western coast of the Bhuket Circle. These forests run in a thin strip down the western coast-line of the

Peninsula, from the most southerly portions of Burma to the northern boundary of the Federated Malay States, a distance of approximately 300 miles (500 kilometres). The greater part of the coast-line is occupied by these forests, though they are not absolutely continuous but are broken in places by long stretches of *Casuarina equisetifolia* woods wherever the beaches are sandys and in other places, where the mountains descend sharply into the sea, the mixed evergreen forests extend right down to the water. The width of the strip varies a good deal according to the size and length of the creeks which carry the salt water inland.

The total area of these mangrove forests has been roughly estimated at 800,000 'rai' (320,000 acres). The absence of accurate topographical maps makes it impossible to give exact figures, but the above figure may be taken as being on the safe side.

For the purposes of Forest Administration the forests are divided into eight Sub-Divisions, each of which contains a Sub-Divisional Officer with headquarters at a Forest Duty Station, together with Sub-Duty Stations at other places in the Sub-Division.

The main products of these mangrove forests are timber, poles, fishing stakes, mining props, attap-palm leaves, fuel charcoal and tanning barks. There are also a small number of minor forest products produced by these mangrove forests, but they are not of very great economic importance.

The main characteristics of these and similar types of forests are that they are coastal strips of thick muddy tidal swamps interested by numerous waterways of varying size. Under these singular conditions a limited number of species of trees grow. Most of these trees are endowed by nature with peculiar structures enabling them to flourish in these surroundings. The areas are all tidal, and at high tides considerable portions of the trees are under water. As the swamps extend inland, the ground becomes slightly higher and the tidal action less, in consequence of which the ground becomes harder and less muddy. As a rule, certain of the tree-species prefer and grow in the more muddy and flooded portions, while other species occupy the drier parts; but this division of the vegetation into zones is not clearly marked in the

Bhuket mangrove forests, and species are liable to become mixed in many places.

One of the most noticeable features of the mangrove forests is the tangled mass of roots which appear above the surface of the ground. These roots, which are known collectively as air-roots or pneumatophores, have a spongy texture and absorb air which serves for the aeration of the root-system. They assume many different forms.

The following is a brief summary of the chief kinds of trees growing in the Bhuket mangrove areas, with their main characteristics and uses.

The *Rhizophoraceæ* family are the true mangroves, and include some of the most important and typical species.

The members of this family are distinguished at once from all others by the fact that the seed germinates and produces an elongated seedling known as the hypocotyl before the fruit drops from the tree. Eventually this seedling drops like a dart into the mud, where it remains upright and starts growing and developing into a young tree. In this family the genus *Rhizophora* stands out from all others by the fact that the trees of the various species which compose it grow up in the air, so to speak, on peculiar stilts—or prop-roots. The base of the trunk of a large tree will thus be from one to two metres above the ground with the roots all round it, like props, supporting the trunk.

The following species are found in the Bhuket forests, *Rhizophora mucronata* (Mai Pangkā Bai Yai) and *Rhizophora conjugata* (Mai Pangkā Bai Lek). In Bangkok these two species are known as Mai Kong-Kāng. These species form medium-sized trees and it has been estimated that they reach a girth, at breast height, of 50 centimetres in 35 years or so. In the Bhuket forests they rarely exceed 1½ metres in girth. They produce excellent fuel, charcoal and tanning-bark. The timber is hard and heavy, useful for posts, piles and building material, but not very durable when exposed to the weather.

The next important genus in this family is *Bruguiera*. This is represented by three species of trees, none of which develops stilt-roots.

Bruguiera gymnorhiza (Mai Pangkā hua sōm) is the largest of the true Mangrove family. It is generally found growing as scattered single trees. In very favourable situations it has been known to grow to 25 metres in height, but in these forests it rarely, if ever, attains such proportions, though trees with a girth at breast height, of 175 centimetres are not uncommon. This genus also produces good fuel and charcoal. The bark is claimed to be a good tanning material, but it is not in demand as the supply is very limited, and it has been found difficult to strip the bark from the bole of the tree. The timber is hard and heavy, but not at present in demand for building and other purposes.

There are, besides the above, two other species of *Bruguiera*, *Bruguiera parviflora* (Mai Tūa Kāo) and *Bruguiera* sp.: (Mai Tūa Dam), which closely resemble the species already described.

The last genus of the true mangroves, *Ceriops*, is represented in these forests by *Ceriops Candolleana* (Mai Samê). It grows gregariously, and does not develop stilt-roots, but often aerial roots are dropped down from the sidebranches and thus anchor the tree to the ground. In the northern portions of the Bhuket forests the tree commonly reaches 20 metres in height and one metre or more in girth at breast height. In the southern parts of the forests the tree has almost been worked out. It produces good fuel and charcoal, but it is chiefly in demand for its excellent tanning-bark, which is the best of all for this purpose. The bark contains much red colouring matter, and a good red dye can also be extracted from it The timber is yellowish, hard, close-grained and very durable.

The next family of trees to be mentioned is the *Meliaceæ* family, represented by two species of trees, *Carapa moluccensis* (Mai Tabun Dam) and *Carapa abovata* (Mai Tabun Kao). Both these are medium-sized, straight-growing trees with well-developed boles, and produce good serviceable timber. The wood is hard, durable, seasons well, and takes a good polish. When freshly cut it is purplish in colour, but turns a fine dark red-brown on seasoning. It is much in demand for furniture and house-building.

The family *Combretaceæ* has one common representative in these forests, namely *Lumnitzera coccinea* (Mai Tam-sao Nu or Mai Tam-sao Tale), which is a medium-sized tree commonly growing in the drier inland portions of the mangrove forests where the soil is only periodically flooded. It produces a useful all-round timber, yellowish-brown in colour, and fairly hard and durable.

The above represent the common trees of economic value, but the following common trees, though not economically valuable, and sometimes even the reverse, are worthy of mention.

Avicennia sp: (Mai Api-api) of the *Verbenaceæ* family is unfortunately very common everywhere. It is a most undesirable tree as it is perfectly useless; at the same time it grows very fast, it is most resistant and difficult to eradicate, it takes up much room and constantly suppresses and crowds out other valuable species of trees. Efforts have been made by the Forest Department to exterminate it in some places. But this is very difficult to do, as even when the tree is cut down, it sends up masses of strong stool shoots. When girdled it often sends down aerial roots from above the girdling point.

Sonneratia acida (Mai Lampu) of the *Sonneratiæ* family is a small tree generally growing in the water on the edges of 'klongs.' The wood is soft and valueless, but the air-roots are sometimes cut into pieces and used as corks for bottles.

Excæcaria Agallocha (Mai Tātum or Mai Mu-ta), belonging to the *Euphorbiaceæ* family, is a small tree growing in the drier inland portions of the forests, which has very poisonous qualities and is of no economic value.

In addition to the above trees, the well-known *Nipa fructicans* or Attap-palm, locally known as 'Chak' must be mentioned. It is found growing here and there, as a thin fringe along the waters edge, in most parts of these forests. It is too well-known to need any further description here.

There is a very large demand for fuel and charcoal in Changvad Satul and the southern half of Changvad Trang, and the forests in those parts are being heavily worked, in fact overworked, to supply the demands of the Penang market.

At present there is no systematic method of exploiting the forests; the forest products are exploited by the purchasers on permits, and the only measure of protection and conservation is the closure of certain forests to all felling. The fuel trade is in the hands of Chinese, who run it in an organized fashion. The Chinese fuel contractors have regular felling camps in the forests where the Chinese coolies live. The coolies go out in boats, fell and bring back the trees, which are sawn up and split into billets 50 centimetres long at the camps. The contractor pays the coolies 40 satangs per 100 fuel billets loaded on board the junks. The Penang fuel merchants send the junks, which are able to go up the large creeks well into the forests, and they pay the local contractors at the rate of 40 cents (Straits) per 100 split billets. The Government levies a royalty of 10 per cent. *ad valorem.*

The charcoal business is also in Chinese hands, and is similarly organized in large charcoal-burning camps in the forests. In making charcoal, round logs 50 centimetres and upwards in girth are used. After being brought to the camps in boats, they are sawn into lengths of about 2 metres 30 centimetres each, before being packed into the kilns for burning.

The charcoal-kilns are circular in shape, built of burnt or unburnt bricks or of both, set in mud mortar. The top of the kiln consists of a conical brick dome. The thickness of the walls is about 75 centimetres. The usual diameter of the kiln is 5·5 metres, and the height of the walls inside the kiln is about 2 metres. Each kiln has a door about 75 centimetres in width and one side-flue about 50 centimetres broad. In addition, there are three air-vents which run from the circumference of the dome downwards: these are shallow notches cut down the whole height of the walls of the kiln.

The logs are stacked vertically in the kiln until the dome portion is reached, and there they are laid horizontally. After charging the kiln the door is bricked up, and the kiln is fired from the base through the side-flue. The larger sized kilns hold 50—55 cubic metres of stacked fuel, while the smaller kilns hold 48 cubic metres approximately of stacked fuel. The out-turn of charcoal from a small kiln is about 100 piculs weight. It takes about

three weeks for a kiln to burn and thereafter ten or twelve days are necessary before the charcoal is cool enough for the kiln to be opened and the contents removed. Large substantial sheds are erected over the kilns to keep off the rains and violent winds, and to protect them generally against the weather.

When ready, the charcoal is packed for export into neat split bamboo baskets, which are made on the spot by Chinese workmen to whom the contractor pays three satangs for each basket or five satangs per basket if the former supply the bamboos themselves. An expert basket-maker can make up to 30 baskets daily, but the average is about 20. Three baskets of charcoal weigh approximately one picul. The selling price on the spot per basket of charcoal f.o.b. junk is 45 satangs ; and when packed the baskets are despatched to Penang. The Government levies a royalty of 10 per cent. on the value of the charcoal.

The tanning-bark trade is much more irregular and fluctuating. In past years it has chiefly been exploited in the forests in the northern half of Changvad Trang, and in the forests which lie northwards up to the Burma frontier. One of the chief drawbacks has been that the purchasers of the tanning-bark make no attempt to use the wood either for fuel or charcoal after the bark has been removed from the boles of the trees, but simply leave it to rot in the forests. The Government charges a royalty of 10 per cent. on the current selling price of tanning-bark.

The charcoal and fuel trades in Changvad Satul and the southern half of Changvad Trang are very extensive and valuable ; and it has been estimated that, in the Changvad Satul alone, the annual trade in these commodities has a value of Ticals 350,000, and gives employment to about 2,500 people, or roughly eight per cent. of the total population of the Changvad. But, as one proceeds northwards, the demand for mangrove forest products get less and less owing to the increased distance from Penang ; and in Changvad Ranong and Takuapa there still remain large tracts of rich untouched mangrove forests where it is to be hoped that, some time in the future, large organized tanning extract and other industries may be developed.

Last year the following total amounts of fuel, charcoal and tanning bark were extracted by purchasers from the mangrove forests of the Bhuket Province :—

Fuel ...	...	...	256,518 cubic metres.
Charcoal	...	...	23,802 cubic metres.
Bark	...	...	54,083 piculs weight.

It will be of interest to state that, for the last 5 or 6 years, the Forest Department authorities, in the absence of regular topographical maps, have been steadily surveying these mangrove forests from the south northwards, with a view to organizing systematically and controlling the exploitation of these areas; and that about one-third of the area has thus been mapped out. A Working Plan is now being made for the mangrove forests of the Satul Sub-Division, and later on it is hoped to make Working Plans in other sub-divisions, wherever there may be an intensive demand for the forest produce.—[*The Record.*]

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INDIAN FORESTER

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RECENT PUBLICATIONS OF THE INDIAN FOREST DEPARTMENT.

The Forest Research Institute at Dehra Dun has since 1906 been engaged in investigations into forest problems in India with a view to finding out the best ways in which the great natural forest wealth can be protected, developed and utilised. From small beginnings the Institute has grown to great dimensions and employs a large staff of experts, European and Indian. The results of investigations carried out by these experts are published with as little delay as possible in various forms according to the nature of the subject dealt with.

The "memoirs" or monographs deal with subjects which have been fully investigated and from their nature are restricted in number. Fourteen of these monographs have been issued and they deal with such subjects as the ecology of the forest grasses, the silviculture of the chir pine, the economic value of Sal timber, Indian woods and their uses, and the prospects of the match Industry in India. A number of memoirs were also issued on forest insects, most of which do a great deal of harm to the forests, but one is included, the lac insect, which is the source of the raw material of one of India's great industries.

Some 80 Forest Records have appeared and these deal with a great variety of subjects which are not, as a rule, suitable for monographs. In some cases the Records relate to the results of investigations not yet completed, in cases when it was thought that the public interest would be served by publishing what had been discovered without delay. In other cases the experiences

of local forest officers were utilised so that their knowledge might be made available to the public while it could be dealt with by some one on the spot who was well acquainted with the matter in hand. With the exception of a dozen all of these Records were written by the staff of the Forest Research Institute and the subjects they deal with are many and various. Eleven of them deal with forest insects, twenty-one with Indian silviculture and five with Indian botany. On the utilisation side four deal with timbers, thirty with minor products, and three or four in each case describe progress under the important heads of timber preservation, timber seasoning, timber testing and the materials for paper pulp, a matter of great interest at the present time.

The smaller publications have appeared as bulletins, pamphlets and leaflets, and these total nearly a hundred. The staff of the Forest Research Institute are respons ible for about four-fifths of these and they range over a great variety of subjects, including even notes on transport of timber in America, which were considered of value to Forest Officers in India. One of the special lines of the bulletins has been short monographs about Indian timbers which are of value and are little known. These notes give all that was known at the time they were published regarding qualities and prices of the timbers, where they can be obtained and quantities available, and have appeared for twenty-seven kinds of timber trees. Each bulletin deals with one timber and contains a sample of the timber as a thin veneer. A dozen of the bulletins deal with minor products such as turpentine, tanning materials and lac, and twenty of them deal with insects which do harm in the forests. Certain aspect of timber strengths, timber preservation, etc., are dealt with in nine of them, and silviculture and botany take up most of the remainder.

In the publications described the officers of the Forest Department have endeavoured to put their knowledge before the public in a cheap and handy form with the least possible delay and are at all times ready to supplement what they publish with information on any particular point. No finality is likely to be reached in the acquisition of knowledge regarding the forests of

India and their products for many years to come and it is the desire of the Officers of the Department that the public should immediately be put in a position to use such information as has been collected. Particular attention may be drawn to the very great potential value of the minor products of the forests, such as raw material for paper pulp, tanning and dyeing materials, fibres, flosses, gums, resins and oils.

The Memoirs, Records and Bulletins can be obtained at cheap rates from the Government of India, Central Publication Branch, 8, Hastings Street, Calcutta, or through any reputable book-seller in India or Burma. In England the High Commissioner for India, 42, Grosvenor Gardens, London, S. W. 1, will supply all information. A complete list of publications appears six-monthly in the *Indian Forester* and enquiries may also be sent to the President, Forest Research Institute and College, Dehra Dun. A number of the most interesting publications have appeared during the years 1923, 1924 and 1925 and attention may be drawn to their most useful features, each group being described under a general heading.

SILVICULTURE.

During the years 1923—25 the silvicultural information that has been amassed has been very considerable and covers a great deal of ground. Mr. R. S. Troup, who is now Professor of Forestry at Oxford, published in 1921 a magnificent work in three volumes which contained all that was known up to date about the silviculture of Indian trees. His data naturally did not extend right up to the time of publication, and a great deal of information has been collected during the last few years, especially owing to the appointment by several Local Governments of Provincial Silviculturists and to the development of the Silvicultural Branch at the Forest Research Institute. It will be sufficient to summarise here the principal subjects recently dealt with.

Various species of Eucalyptus have been known as most valuable exotics for India for a long time and visitors to Ootacamund do not need to be told what splendid results can be obtained by planting these handsome Australian trees in the Nilgiris. There

are very many species of Eucalyptus and it has been believed at times that one or other of them could be used to form a forest where nothing else would grow. This belief is hardly justified, and Mr. Parker, Forest Botanist at Dehra Dun, gives an account of what can be done in the plains of N.-W. India. Certain species can be grown with success, but it must be remembered that Eucalpytus does not like the hot muggy weather that so often follows the first rains in the plains. Mr. Parker has also published a second bulletin on Eucalyptus, describing the attempts that have been made to grow it in the hills, but his conclusions are that Eucalyptus will be only of limited value in forest work (as distinct from garden and park work) in the Himalayas, unless a species can be found that will regenerate naturally and thus save the expense of planting.

Another interesting exotic is the camphor tree, a native of Formosa and the Far East belonging to the cinnamon family. It is a common shady avenue tree in upper India and a few attempts have been made to grow it in plantations. Messrs. Howard, Robertson and Simonsen combine to make public what is known of the growth and utilisation of the camphor tree in an interesting illustrated Record. Japan controls most of the world's supply and the destruction of the trees led many people to think that there might be a great deal of money in a camphor plantation, such as was started in the Shan States in 1913. Great difficulty was found in the cultivation at first but the work was successful later on and it is expected that camphor will be obtained on a commercial scale. Experiments were made at Dehra Dun over one-fifth of an acre where the plants were coppiced. The leaves were plucked from the bushes so formed as if they had been tea-bushes and the camphor was distilled. The authors come to the conclusion that Dehra Dun is not a suitable place to grow camphor as a commercial proposition, and recommend that it be tried only in tropical climates. The warning is given that little profits are likely to be made unless prices rise very much.

Mr. H. G. Champion, I.F.S., has written a very scientific Record on twisted fibre in trees. This puzzling phenomen has for years engaged the attention of forest officers and botanists, parti-

cularly in N.-W. India, where the long-leaved pine is very liable to this serious defect. Mr. Champion, whose Record contains a large number of photographic illustrations, goes into the subject fully from the beginning and comes to the conclusion that it is a character common to all trees to produce a varying but small proportion of individuals with twisted fibre, that where it is common, twists may be transmitted from one tree generation to the next, and that sound forest management, especially as regards seed selection and thinning, should result in time in the elimination of the twisted trees.

A most interesting Record was published in 1925 by Mr. H. R. Blanford, Conservator of Forests, Burma: "Regeneration with the assistance of *Taungya* in Burma." Mr. Blanford has during the last ten years given a great deal of attention to this subject and is the recognised authority on it. *Taungya*, a word which is now used by forest officers in India, is a Burmese word meaning temporary hill cultivation. The destruction wrought in past ages in the hill forests all over India and Burma by this system of cultivation is well known, and it is believed that Burma forest officers first made use in 1866 of this time-honoured method of making a living to establish teak plantations. Mr. Blanford's Record, which contains a number of good photographs, describes fully this method of forming valuable forests and its modern developments. It is of interest to note that this system of increasing the value of the forests is being employed more and more every year with success in India, as well as in Burma.

Dealing with the more purely technical side of silviculture five bulletins and records have recently been published by Mr. Howard, Silviculturist at Dehra Dun, one by Messrs. Smythies and Howard and one by Mr. Maitland, Silviculturist in the Central Provinces. These deal with volume yield tables for the more important species, such as teak, sal and long-leaved pine, and are useful to forest officers who wish to calculate the quantities of timber available from forests of various types. The figures have been obtained from many thousands of measurements made during past years, principally by the officers of the Forest Research

Institute, in many parts of India. Several of these small books are published in pocket size so that they may be easily carried in the forest.

FOREST ECONOMY.

Dealing with the very important matter of the utilisation of forest products, a great deal of literature has been published and a short description of the more recent volumes will be given.

The question of sleepers for Indian Railways has received much attention from forest officers and a great deal of work on the subject has been done at Dehra Dun. It is now possible to supply the Railways with reliable information on the timbers which are best suited for sleepers, where they can be obtained, how they should be treated to give the best service, and figures of cost. Mr. R S. Pearson, who recently retired from the post of Forest Economist at Dehra Dun, which he had occupied for fifteen years, was the pioneer in the systematic study of the sleeper question, and he and his assistants have published a number of useful treatises on the subject. Bulletin 53, by Mr. Pearson, published in 1923, gives the results of treated and untreated experimental sleepers laid in the various railway lines. These sleepers of a number of different species, treated with a variety of preservative chemicals and oils, were put into the lines in the ordinary way, and the results show the great advantage of treating the less durable (though hard) woods for this purpose. A similar Bulletin No. 59 was published in 1925 by Mr. Warr, Officer-in-Charge, Wood Preservation Section, Forest Research Institute, Dehra Dun, which records the results of many similar experiments, some of which began in 1910. The author concludes that Powellising and treating with fairly large quantities of Creosote, or a mixture of Green oil or Avenarius Carbolineum and Earth oil, have given equally good results. It is economically unsound to treat sleepers with Chloride of Zinc, followed by a small coating of Creosote. The results are clearly summarised in coloured diagrams.

Record, Vol. IX, Part IX, by Mr. J. V. Collier, I.F.S., deals with the extraction of Broad Gauge sleepers from Nepal. Mr.

Collier was entrusted with the task of extracting from Nepal 200,000 sleepers offered by the Government of Nepal to the British Government as a war gift. He found the problem a difficult one, as the Raman forests, which were to be worked, were completely land-locked, and a tramway was built. The character of the cliffs which had to be negotiated will be realised when it is stated that the gorge, the natural outlet from the Eastern Kumaon, had never been trodden by the hillmen who lived a few miles above it. A ropeway was also built. Mr. Collier was extremely successful in his enterprise and has continued to work *sal* forests of Nepal on behalf of the Nepal Government ever since. A number of interesting photographs and technical drawings are issued with this Record.

A Record of the most recent work on sleepers in Assam, by Mr. Warr, has recently been issued.

The most recent bulletin dealing with a single timber, by Mr. C. C. Wilson, I.F.S., Madras, was published in 1925. The timber dealt with is *Ainee* (*Artocarpus hirsuta*) and a piece of the wood, in a cardboard mount, is bound with the bulletin. According to the map given, it is found along the hills of south-west India from Canara to Cape Comorin. The timber is white-ant-proof and extremely durable on land and in water. Mr. C. G. Rogers, who was Chief Conservator of Forests in Burma from 1913 to 1919, has published in Bulletins 54 and 55 some of the notes made while taking the forest engineer students round the United States of America. Dry slides and flumes (wet slides), animal haulage, caterpillar tractors, and portable sawmills, are fully described and illustrated, and many notes are given which may be of use to those interested in timber exploitation in India.

On the purely technical side of forest utilisation Mr. Seaman published in 1924 (Record, Vol. X, Part VII) a report on the work done on mechanical and physical tests on Indian timbers.

Mr. Seaman was trained in Canada and is an expert on the use of the specialised modern machinery used in testing timbers. In the testing shop at Dehra Dun, of which Mr. Seaman is in

charge, teak is taken as the standard, its strength values being taken as 100, and the values for other timbers being expressed in corresponding figures. He also gives tentative grading rules for Indian structural timbers.

Mr. W. Raitt, who is in charge of the Paper Pulp Section at the Forest Research Institute, has recently published a Record, "Summary of Investigations on Bamboos and Grasses." Mr. Raitt has been engaged on this enquiry for a long period and has recently been successful in evolving a method of manufacturing pulp from bamboo which is greatly in advance of anything that has been done up to date.

Mr. J. A. Pilgrim, who was in charge of the Tans-section of the economic branch at Dehra Dun, has published two Bulletins (Nos. 56 and 57) and four Records (Vol. X, Parts V, IX, X, XI) on the tan values of various Indian forest products. These include the well-known Indian Myrabolans, and the bark, leaves and wood of five species of *Terminalia* from Burma. Valuable tannin properties were obtained from some of these. He also investigated the wood and bark of the *Khasya* Pine and of Burmese *Pyingado* (*Xylia dolabriformis*). He recommends to those interested the bark of *Khasya* Pine as a very valuable potential tanning material for medium and heavy leathers. *Pyingado* bark gives a tannin of the class of Mimosa. In the report on the *Lagerstrœmias* of Burma by Messrs. Pasupati and Pilgrim the results of a large number of investigations are given and the following are recommended as suitable for the manufacture of tannin extract:—*L. villosa*, leaves and trunkbark; *L. Flos Reginæ*, fruit and leaves; *L. macrocarpa*, leaves, trunkbark and fruit; *L. tomentosa*, leaves.

The *Dipterocarps* are a very large and important family in Burma and six of these were examined. Three of these trees gave no promising indications but the bark of three others, *Pentacme suavis*, *Shorea obtusa* and *Hopea odorata* gave fair results. The bark of the last-named appears to yield tannin of the same class as that obtained from oak-bark and tans to a very beautiful cream shade, and the bark of *Pentacme* gives a

good leather and should be useful in local tanneries. *Shorea* gave a useful tannin from the bark and from the wood.

Mangrove forests have long been the source of tan-barks and Mr. Pilgrim reports at length the results of his investigation into the tanning properties of all the important tidal species of Tenasserim. These forests, being close to the sea, are as a rule easy to work and many of the trees have valuable tanning properties. Some of the Burmese oaks and chestnuts also, which grow over considerable areas on the hills of Upper Burma and the Shan States, were found to contain valuable tanning properties and Mr. Pilgrim made good leather with the extracts of several of the barks and woods.

Dr. Simonsen, who was Forest Chemist at Dehra Dun, and his assistant Mr. Gopal Rao, have published a number of Records (Vol. VIII, Part V; Vol. IX, Parts III, IV, VI and VIII; Vol. X, Parts I, II, IV and VIII; Vol. XI, Parts I, V and VI) on the oils and resins obtained from important Indian forest plants. Among these are oils from leaves of blue pine and Himalayan Cypress, oil from fruits of Juniper and *Aleurites*, and the resins of the long-leaved pine, *Pinus Gerardiana*, *Pinus Merkusii* and *Boswellia serrata*. These records contain much interesting technical information.

Two important records have been published recently by the entomological branch, by Dr. Beeson, Messrs. Gardner, Chatterjee and Kleine. From a forest point of view the most interesting is Vol. XI, Part VIII of the Records which gives a full account of the *sal* heart-wood borer, a beetle of the family Cerambycidæ. This pest has done very great damage in the *sal* forests of the Dun and the measures taken to deal with the attack and the great success achieved are fully described, with many illustrations. Dr. Beeson estimates that this beetle has been responsible for an annual loss in the *sal* forests owned by the State in India, of 2½ lakhs of rupees.

The last Record to be noted in this article is of special interest to systematic entomologists. Herr R. Kleine of Stettin, Germany, describes in his own language a number of new Indian

Brenthidæ, and Dr. Beeson and Mr. Gardner give further information about this family of beetles which is essentially characteristic of the forests of tropical and sub-tropical regions, with very few representatives, in Europe and North America.

SIMLA TO CHAKRATA.

Mr. Gamble wrote an account of the journey through the hills from Mussoorie to Simla in the *Indian Forester* for 1898, and this is a record of a journey from Chakrata to Simla done in October 1925, by the same route in the opposite direction. Simla to Fagu is a well-worn and rather dull stage which need not be described again and the tale will begin from the departure from Fagu. Leaving the Hindustan-Tibet road we plunged down a very steep, very rocky and very rough track which wandered down bare ridges for nine miles to the river Giri. By that time we had worn the toes out of our stockings and were glad to rest for tiffin on the river bank. The river was low and cold so that attempts at catching mahseer were in vain but the deep pools and the grassy meadows made an ideal resting place, while the mules struggled along to Deha. Quite a large area of flat arable land lies beside the river, at Sainj, the headquarters of the Raja of Theog, where his ancestral residence stands on a little promontory above the Giri river. The curved roof and projecting balcony give an almost Chinese air to this very picturesque feudal stronghold. From the Giri to Deha is an exceedingly steep rough climb of eight miles which we accomplished in three hours with the aid of stout little hill ponies lent us by the State. There is little forest until the path gets near Deha which lies at 6,500 feet looking down into a deep valley. As we approached Deha we were struck by the appearance of numerous bushy trees which seemed to be of some new species and discovered finally that they were *Moru* oak trees thickly overgrown with *Loranthus cordifolius,* which is evidently of long standing, as Mr. Gamble records that it was very plentiful when he passed through in 1898. It is not so harmful as it looks, because the valuable trees in this forest are

blue pine and deodar, and the *Moru* is unmercifully lopped. Along these hills the blue pine has a most lamentable appearance as wherever the forest has not been reserved the side branches have been repeatedly lopped for litter until the tree has the shape of a long thin brush used for cleaning lamp-chimneys. The trees are tall and straight and have a very small crown at the top, but even in the reserves the old ends of the lopped branches are eloquent of the destruction that has been done. The lopping facilitates the attacks of the evil fungus *Trametes pini* and many of the trees are rendered entirely useless from this pest. The State of Bulsan has a comfortable rest-house at Deha, or Daya, as the one-inch map calls it, perched above a deep valley tributary to the Giri, with fine deodar, blue pine and spruce forests rising to 8,500 feet behind the bungalow. A few hundred feet below, at Barog, are some 60 or 80 acres of deodar of excellent quality, tall trees with a very few of the origina. 400 year-old trees and many fine 6 to 8 feet stems. In this specially suitable locality natural regeneration of deodar is springing up beautifully in the light shade of the old trees, which will be felled very soon, and this area is an excellent example of what Indian States can do in the way of forestry in the hills under proper guidance. Near Daya is an area where many of the tall thin lopped blue pine are standing over young deodar, which are now developing well and will make a good forest as soon as the tall but miserable blue pines have been removed. From Deha to the rest-house at Chupal in the Jubbal State is 16 miles. The first seven miles led steadily uphill through moderate forest of *Moru* and *Karshu* oak, deodar, spruce and blue pine. From the Paternala ridge we had a splendid view of the central Himalayan Range, with the snowy tops, 22,000 feet to 24,000 feet above the sea, of Badrinath, Bunder Punch and Jamnotri conspicuous. We climbed to the top of a crag of 9,000 feet near Paternala where we had lunch and admired the view, the 12,000 feet Chor to the south and the snows to the north. An uneven road from Paternala leads down to Chupal, eight miles, the forest being at first fine old spruce and silver-fir with a few deodar and yew trees. The spruce

trees are tall and straight, 150 feet in height and 6 to 10 feet in girth. Below this there was until 1921 good blue pine forest on all the slopes but in that year a series of devastating fires took place and some 4,000 acres have been ruined. Where patches of deodar and spruce occurred the damage was small but the long slopes formerly covered with blue pine are now like the pictures of the devastation caused by fire in America. It will be many years before this damage, which can probably hardly be surpassed by anything of the kind in India, can be made good, but the forest authorities of Jubbal State are taking the work in hand. The valuable timber has been extracted and the burnt areas are being gradually cleared. The timber and brushwood is felled and is burnt in September and the cleared areas, which then exactly resemble well-cleared *taungyas* in Burma, will be sown with deodar seed in strips and patches in November. The snow provides a covering and the young seedlings will appear in the spring.

Near the extremely comfortable forest rest-house Chupal deodar of fair quality with many seedlings is abundant and the view to the south-west, looking up a broad valley to the Chor is magnificent. All the upper slopes of the valley are covered with blue pine, deodar, spruce and silver-fir forest and below that every broad descending ridge is laid out in terraced cultivation, glowing, in early October, with the bright crimson and red-brown of the fields of Amaranth. Below the rocky summit of the Chor can be seen patches of *Karshu* oak and birch, and the mountain forms a very fine background to the beautiful valley in which lies Sarain.

Descending a very steep path for an hour and a half, the traveller passes from blue pine and deodar into chir pine, rather open grassy slopes with pines of good girth, some *ban* oak and patches of fine seedlings, the elevation above sea-level being about 5,500 feet.

All the forests on the surrounding mountains are being worked, and the sleepers and beams come down to the Shalwi river which joins the Tons below Tiuni. It is fed by a number of smaller streams such as the Shantha and the Hamalti which

are used to bring down the timber, though the ordinary traveller would think they were much too small to be of any use for this purpose. In the Shantha is a wet slide of the type so often described in past days, and in the Hamalti valley no less than 600 men are engaged in urging the timber down a length of 7 miles, by the "telescopic" method of extraction. This is even better seen in the main river where some eight miles are full of sleepers, as many as 15,000 to the mile. This telescopic floating, through familiar to forest officers of the Himalaya, seems extremely ingenious to the outsider. The bed of the stream is adapted by the men so that the sleepers keep moving down the central channel which is kept clear. Other sleepers and baulks of wood are used in large quantities to build up walls along the narrow central channel, and at numerous places short shoots are constructed and the sleepers slide over these and plunge into the pools below. Men are posted at all the points where stoppages can possibly occur and their business is to keep the sleepers moving. When they go to sleep there is a jam. In November the cleaning-up party come down from the tops of all the streams working all the sleepers down, and it is expected that this year about quarter of a million pieces of timber will reach the Tons and thence the Jumna. Peontra bungalow, picturesquely situated on a small plateau covered with chir forest, lies some 700 feet above the river, and here we spent a very comfortable night. The next day a toilsome march of 10 miles brought us to Tikri, a village lying at 6,400 feet on the top of a bare ridge. The path leads down to the Shalwi, where species such as *Odina*, *Callicarpa*, olive, and *Shisham* are found at their highest elevation, and then climbs across to the deep valley to the east of Tikri, from which an exceedingly steep path leads up to the village, where most of the inhabitants were clustered on the roofs and walls to have a look at us. We had now reached the eastern border of the Jubbal State and spent a long day exploring the heights to the north of Tikri. Climbing early in the morning from 6,400 feet to 8,500 feet we walked north along high ridges covered with splendid deodar, spruce, and silver-fir till we reached the Bherach Tibba

which is over 10,000 feet. Game was little in evidence as several large flocks of sheep had come up to graze on the mountains and the men in charge had been wandering everywhere. Tharoch, Jubbal and Jaunsar join near this point and we returned to Tikri through the Murach forest in Jaunsar.

Bidding the Jubbal officials good-bye and thanking them for their great kindness to us, we climbed up to the Murach ridge again and descended from 7,600 feet to 3,000 feet to the rest-house at Tiuni. The suspension bridge over the Tons, which was carried away by the floods of September 1924, has been replaced, and Tiuni, though rather a warm hollow, is very attractive with its grove of walnut trees and the Tons foaming down through great rocks. The water was too cold for mahseer but we swam in the fine pools several times. Between Tikri and Tiuni there are good areas where oaks have been girdled to favour deodar and blue pine with very good results, and near Mundole there is good blue pine forest and in the valley very fine old chir on grassy slopes. The last three halting places, which are in the Chakrata Division, are Kathian, Mandali and Deoban, and the whole of this country has been so often described and is so often visited that no more need be written. The whole distance from Simla to Chakrata is about 120 miles, most of it on remarkably rough steep stony paths, and those of obese habit or luxurious ways of life are advised not to undertake it, unless with first-class hill ponies to carry them. A few pheasants and chikor are to be found on some of the hills but no great quantity of game was seen.

A. RODGER, I.F.S.

EXTRACTS.

THE TIMBER RESOURCES OF HUNGARY.

Some idea of the tremendous loss in forest wealth sustained by Hungary as a result of territorial changes consequent on the war is given in a report issued by the Budapest Chamber of Commerce and Industry, and to say the least, it is a little surprising. In the pre-war period the timber production of the forests of the Carpathian and Transylvanian mountain ranges, together with the extensive saw-mills, was sufficient not only to fulfil the whole requirements of Hungary, but also to export considerable quantities of timber. After the conclusion of the Trianon Treaty it was actually necessary for Hungary to import timber for her own use. The forest lands of pre-war Hungary covered roughly 7,400,000 hectares of which oak comprised 26·5

per cent., beech and other foliaceous timber 44·5 per cent. and pine 24 per cent. To-day the forest lands of Hungary consist of only 1,167,328 hectares, of which about 50 per cent. are covered with oak, 44 per cent. with beech and other foliaceous timber, and 4 per cent. with pine. The country's entire forest area is now therefore not more than 15·75 per cent. of what it possessed before territorial dismemberment. It will be noted also that a great alteration has taken place in the proportion of the different kinds of timber. Moreover, the great loss to the Hungarian timber trade is further emphasised by the fact that the forest lands left to her are not the excellent timber-growing regions, but quite second-rate areas situated in a more or less arid climate; besides which considerable tracts are unfit for clearing, consisting merely of undersized saplings. Along with the forest lands, of course, went saw-mills. Hungary has lost her most modernly-equipped and efficient mills amidst or in the vicinity of the primeval forests of Northern Hungary and Transylvania, and to-day she possesses only 228 as compared with more than 1,100 in the original Hungary. It should also be noted that the productive capacity of her present mills is unsatisfactory, in consequence of a good proportion being out of date, and often temporary water mills. In spite of a bad year in 1924, the prospects of Hungary's timber industry, however, are not altogether unfavourable and its staying power was proved in the economic crisis at the end of last year.—[*The Timber News.*]

THE CONTROL OF WHITE-ANTS.

Different remedies and preventives must be instituted in case of damage by the two groups of termites—namely, those that are subterranean in habit, and those non-subterranean, living in wood. Nearly all cases of damage to buildings by subterranean termites are due to careless or faulty construction.

SUBTERRANEAN TERMITES.

The remedy for and prevention of subterranenan termites of the family Termitidæ are practically the same—namely, complete insulation or isolation of all untreated wood from the

ground. Since subterranean termites always require access to damp earth, when the source of moisture is shut off the insects will not be able to extend their galleries further and will perish. If such termites already in the wood are shut off from the source of supply of moisture in the ground, they will soon perish, since they cannot live without moisture. It is not necessary to do anything more, since the insects will die when the infested timbers are disconnected from the earth, and, furthermore, such infested timbers need not be removed or replaced unless seriously weakened structurally.

Where stone, brick, or concrete foundations are not used, all timbers in contact with the ground should be impregnated with coal-tar creosote.

Injury to living vegetation by wood-boring subterranean termites can be prevented by clean cultivation and proper horticultural management. Injury is more common in the new soil of recently cleared wood-land containing old decaying stumps, wood, or much leaf mould. It is not desirable to use animal manure where damage by termites is serious.

In the case of species of termites of this family which are not wood-boring but which are subterranean in habit and injure vegetation and build mounds in fields which it is desired to cultivate, their galleries should be fumigated with sulphur or arsenic or a combination of the two. There are several effective machines on the market which generate fumes of these poisons in a brazier and force them into the termite galleries by means of a pump. Another method is to fumigate by termitocid cartridges which generate volatile arsenical combinations that enter the galleries under great pressure. Termites can also be controlled by placing poisoned bait in their burrows or nests or by poisoning the soil with poisonous solutions or salts.

Much injury to living vegetation by either class of subterranean termites can be prevented by clean cultivation.

NON-SUBTERRANEAN TERMITES.

Termites that do not live in the earth—namely, such species as Kalotermes, Neotermes and *Cryptotermes*, cannot be com-

batted as can the subterranean species by shutting them off from their supply of moisture in the soil. They infest even dry wood directly through crevices, cracks or decayed places and require little moisture. Of course their breeding places in decayed wood should be destroyed. Where these species are abundant windows and doors in buildings should be screened, especially during the period of swarming or flight. In unscreened buildings the lights should be put out during the swarm. Since species in these genera swarm at night and are attracted to lights in large numbers the winged adults can be caught by placing under the lights large shallow receptacles full of oil or water.

The unprotected woodwork of buildings should be impregnated with chemical wood preservatives. If a coating of the brown creosote or carbolineum is not suitable in the case of interior wood work, impregnation of the wood with a 6 per cent. solution of zinc chloride or a 1 per cent. solution of bichloride of mercury is recommended. A 2 per cent. solution of sodium fluorid is effective as is also impregnation with chlorinated naphthalene, the best method of treatment when using the soluble wood preservatives is by the "open tank."

Possibly the chlorinated napthalene is the best treatment for furniture. Wood must be impregnated before it is made up into furniture if it is to be effectively protected; no known solution applied externally is satisfactory.

Much of the damage caused by white-ants to furniture and interior woodwork in the Tropics is due to the improper construction of buildings. All wood in contact with the ground should be thoroughly impregnated with coal-tar creosote. [*H. F. Dietz and T. E. Snyder in Biological Notes on the Termites of the Canal Zone, Panama, Journal Agricultural Research, XXVI, No. 7.*]

FORESTS OF INDIA.

SIR CHARLES WOOD'S FORESIGHT.

To the Editor of the "Times."

SIR,—In the article by your Correspondent in *The Times* of October 31st on Sir Charles Wood's reforms in India one not

unimportant side of administration in which he took a decisive line is not mentioned.

In November 1862, the Governor-General in Council addressed a dispatch to the Secretary of State, in which he pointed out the neglect to which the forests of the country had been exposed during the previous 60 years—that in most provinces the accessible forests had been, or were being, ruthlessly exploited, that timber was becoming scarce and prices high in certain areas, while in many parts of the country fuel was in the same position. He intimated that he was bringing Dr. (later Sir Dietrich) Brandis from Burma to act as adviser, with the object of introducing some form of administration over the forests of the country in order to safeguard those which remained. It was time! For, as an aftermath of the Mutiny, railway construction was to be pushed with energy and the demands for timber from the forests would inevitably be heavy. Sir Charles, Secretary of State, after cordially concurring with the recommendations continued :—

"It is very evident, as you state, that the want of system hitherto existing in all parts of India, but more especially in the Bengal, North-Western and Central Provinces, has been one of the chief causes of the waste and destruction to which the forests have been subjected. It arose, no doubt, from a want of due appreciation of the real value of the forest to the Empire. In Burma and Tenasserim, where the late Mr. Colvin began the organization of a Forest Department, the evils arising out of a want of system although they too often obtained, have been mitigated, wherever the Chief Local Superintendent has been a person with such qualifications for the post as Dr. Brandis possesses. But, even in that case, there must be always much to contend with from the demands of private interests, and throughout India also, and particularly of late years, from the growing wants of public departments for timber for the execution of public works. And, as you justly observe, the organization, to be of real permanent utility, must not depend mainly or essentially on extraordinary personal acquirements or activity, but the machinery must be such as will work with average men, under the direction of the best of their class.

"The present state of the forests, however much to be regretted, is not surprising in a country where forests were abundant, though difficult of access, where timber was in no great demand and where, on the other hand, land was in great demand for cultivation. Most countries of the world have suffered from similar neglect, and the results have shown themselves, not only in the dearth and consequent high price of timber, but very often in the deterioration of climate, and in the barrenness of land formerly culturable, if not fertile, situated at the base of hills, when these have been stripped of the forests which clothed them, condensed the vapours into rain, and gave protection to the country below them. The subject, however, has of late been more considered, and the conviction has been arrived at that it requires the stability of a settled administration to prevent the present destruction of forest and hand them down in such quantity and conditions as to leave a due supply for future generation. A permanent Government can only be expected to wait long enough to reap the profit obtainable from an article which it takes 80 or 100 years to bring to maturity. Permanency, as far as it can be obtained, is, therefore, of the highest importance in any arrangement for the due administration of forests. And Her Majesty's Government, therefore, entirely approve of your proposal to make a separate department at Calcutta for the control of all questions relating to forests in the Provinces directly administered by Your Excellency in Council."

This dispatch was written in 1863. During the following three years, while still at the India Office, Sir Charles exhibited a wonderful insight into matters pertaining to a general forest policy and this at a time when a knowledge of forestry and forestry science was a dead letter in England. During this period the Indian Forest Department, the first forest department formed within the British Empire, came into being. Again and again in dispatches to the Government of India, we find the Secretary of State supporting that Government in the steps being taken to inaugurate the Department, which was regarded as an undesirable parvenu by most civilian officials and as an enemy by the people of the country. During these years it is not too much to say

that the main lines upon which a forest policy was introduced into India were as much due to Sir Charles Wood as to Brandis. The Government of India had the latter officer to advise them. Where did the Secretary of State obtain his inspiration from? That he possessed it in no mean degree is undeniable. In spite of a detailed search, I have been unable to discover any records in the archives of the India Office throwing light upon the source of Sir Charles Wood's forestry knowledge. He possessed the wide vision of the great statesman, and, as numerous dispatches show, he kept the Government of India upon the new and difficult road they had commenced to travel. Backslidings in a number of cases were met with sharp remonstrances.

To Sir Charles Wood India owes in no small degree the great and valuable forest estate she possesses to-day, an estate of almost incalculable value to the country and its people. As a result of the reforms a crop of, it may be confidently hoped not insuperable, difficulties now beset forest administration and the maintenance by the Central Government, in the interest of the people, of the essential control over the general forest policy of the country. It is of good augury that the Viceroy elect is a grandson of the Secretary of State who realized so strongly the necessity and wisdom of such a control.

I am, &c.,
E. P. STEBBING.

["TIMES."]

To the Editor of the "Times."

Professor E. P. Stebbing strikes an ominous note in his letter in your issue of November 5th. It is certainly impossible to exaggerate the great importance to the people of India and Burma of their forest resources. The greatest apprehensions as to the future must have been felt by all who know the forests and the forest work, and who have watched the course of events during the last few years following the political reforms. Mr. Stebbing says that it may be hoped that the difficulties which now beset

forest administration are not insuperable, yet certainly to those who have been intimately associated with the course of events they appear at present to be very grave. It is indeed fortunate that a descendant of the Secretary of State in 1862 should become Viceroy-elect in 1925—A. L. HOWARD, 38, Trinity Square, E C.3.

["TIMES."]

FORESTRY IN BRITISH GUIANA.

We understand that the Government in British Guiana are initiating a forest service with a view to bringing under efficient management the 80,000 square miles of tropical forests which exist in the colony and which have not hitherto been exploited to any extent. So far the colony's timbers have only been known outside the colony from the small supplies of greenheart timber which have been coming into England for a considerable number of years, but it is known that there are other timbers in British Guiana existing in considerable quantities which, under efficient methods of exploitation and marketing would be almost sure to meet with a demand from the trade. In the past it has been difficult for anybody to obtain any accurate information or any assurance of regular supplies if they took the trouble to establish the timber; in the future, however, the Forestry Department should be in a position to give definite information about the qualities and quantities of the various timbers and what the sustained yield will be. In view of the fact that during the next generation everything seems to point to a world shortage of timber, it is likely to direct attention to the very large areas of tropical forests which exist in the Empire. It seems a wise policy for British colonies to put themselves in a position now to establish their timbers and get them known in order that they may reap the advantage of that world shortage when it comes.

Mr. B. R. Wood, M.A., Dip.For.(Camb.), of the Indian Forest Service, who has had experience in the management of tropical forests in India and the practical use of the woods,

has been appointed as the first conservator.*—[*Timber Trades Journal.*]

WEMBLEY'S GIANT JIG-SAW.

What is probably one of the biggest jig-saw puzzles ever made has arrived in the Tanganyika section of the East African Pavilion at Wembley this week, and is now on view. It is a map of the Tanganyika Territory, three feet square, made entirely of native woods. Twenty-three different varieties of timber were specially imported from East Africa for the purpose. Each province of the Colony is represented by a different wood, and no artificial colouring was used in the making of the map.—[" *Pioneer*," *Trade Industrial and Economic Supplement.*]

THE INDIAN BOBBIN COMPANY, LIMITED.

The Indian Bobbin Co., Ltd., at Clutterbuckgunj, district Bareilly, U. P., has taken over the Government Sawmill and Turnery situated at Clutterbuckgunj, three and a half miles from Bareilly on the main road to Moradabad, together with large stocks of Timber, Stores, Bobbins, etc.

Hitherto most of the bobbins used in Indian cotton and jute mills have been imported, the imports in 1923 being valued at over 57 lakhs.

It will thus be seen that the Company has before it an immense market to tap. The Directors are Mr. C. T. Allen, C.I.E., Mr. J. P. Srivastava, Mr. T. F. Gavin-Jones and Mr. F. F. R. Channer, acting Chief Conservator of Forests, U. P. The Authorised Capital is Rs. 18,00,000, divided into 1,70,000 Ordinary "A" shares of Rs. 10 each, and 10,000 Ordinary "B" shares of Rs. 10 each. The Government is a shareholder to the extent of Rs. 4,50,000.

According to the Company's Prospectus, dated the 18th August, 1925, 38,581 Ordinary "A" shares are being offered

* A portrait of Mr. Wood, who recently left the United Provinces Forest Service, is published with the article.

for public subscription at par payable as follows :—Rs. 3-8 per share on application, Rs. 2-8 per share on allotment, Rs. 4 per share one month after allotment. The Registered Office is at 121, Civil Lines, Cawnpore.—["*Pioneer,*" *Trade Industrial and Economic Supplement.*]

THE WORLD'S TIMBER.

PRESENT AND FUTURE SUPPLIES.

An important article on the world's timber position appears in "The Economist" received by the last mail. Commenting on a paper on "Present and Future Timber Supplies" read a few weeks ago at the meeting of the British Association at Southampton by Mr. Alexander Howard, perhaps the greatest practical authority on timbers and their uses, the paper hopes it will have some effect in awakening Governments and peoples, and particularly European Governments and peoples, to the fact that whilst there is still a plenitude of wood available to order, the day is not far distant when there will be a general shortage of this indispensable commodity. Needless to say, there will be very few who will disagree with him, and we can endorse his statements by the following observations, some of which have already been touched upon in previous articles in "The Economist."

Of the timber resources of the five continents of the world—Europe, Asia, Africa, America and Australasia—only two affect us as regard present supplies of building woods—Europe and America. To show how ruthlessly the forests of Europe are being cut to-day, it may be stated that on the British timber market we are obtaining, at a price at perhaps not quite 50 per cent. above pre-war level, not only all the building woods we require in sawn deal, batten, scantling, and board sizes, and planed boards but also we are so surfeited with stocks that a slump in values has resulted, occasioning heavy losses to importers here, and still heavier ones to shippers, who have been compelled to sell their wood at less than cost.

Unfortunately, owing to dull trade, heavy taxation, and the recent higher values of wood, the consuming markets on the

Continent have this year not imported so heavily as was anticipated. Possibly they have been using more of their native wood to tide them over until trade was better at Home.

As an illustration of the volume of imported sawn building woods received by the United Kingdom of recent years, the following will be interesting :—

	Loads of 50 Cubic Feet.
January to August, 1925	2,833,973
For the year 1923	4,678,596
" " 1924	5,139,080

The January to August figures this year do not appear large in comparison with the 1924 totals, but the next four months will be a very busy time for receiving cargoes, and will bring the imports well up to the 1924 volume, which was a very heavy one. They are, moreover, 26,457 loads and 381,741 loads in excess of the January-August, 1924 and 1923 imports respectively. Sweden and Finland are cutting wood to their full capacity, their export production being about one million Petrograd standards each (or, as the American lumbermen would put it, 2,000,000,000ft. board measure, each), to say nothing of their domestic demand. The Russian timber trade is increasing rapidly ; in 1923 shipments to the United Kingdom amounted to 600,000 loads of 50 cubic feet in 1924 to 938,800 loads, and from January to August this year, 371,000 loads, and they will continue to increase with the extended trade relations with Great Britain and other European consuming countries.

In brief, Europe, except Russia—who has not yet expanded to her full powers as a wood exporter—is cutting her timber to almost the peak of her capacity (although the poor results of trade this year will tend to a curtailment for a time), but we have no assurance that natural growth and planting are being made to level the enormous annual harvest.

In the United States not merely districts, but States, have within memory been swept clean of their forests—in some cases deliberately destroyed by fire to make room for agriculture. At a recent meeting of the directorate of the National Lumber Manufac-

turers' Association of the United States, held at Portland, Oregon, on the 30th July last, it was stated that: "We are now reaching a period in the history of the lumber business of the United States where the remaining raw material in its mature and virgin state is largely confined to a comparatively small area on the Pacific Coast, and the business of the future will be conducted by much larger units, calling for greater aggregations of capital. This will permit of a closer affiliation than heretofore was even conceived to be possible, and out of it should arise more modern methods of merchandising."

There are still virgin stands of Southern pine (pitch pine) and hardwoods in the U. S. Southern States, but they also are being worked to death. They have supplied more hardwoods than can be disposed of, and lumbermen and millowners are restricting output until the Home and United Kingdom markets improve in demand.

In Canada, including British Columbia, the cutting is colossal not only for their own markets, but for the enormous and ever-increasing demand from the United States, the East, and also fair exports to England. The "cut" will expand year by year.

"Fires are the greatest enemies of the forest, even worse than vermin. In a short article such as this it is impossible to go extensively into the damage caused by fire, but as an example we quote from a letter recently to hand from Mr. Edgar P. Allen, of the National Lumber Manufacturers' Association of Chicago. Mr. Allen says of the McNary Bill, passed in Congress last year, that it lays the foundation of a sound forest policy throughout the nation, and then adds: "I may say that forest fires are at least 75 per cent. of the forest problems of America. There is more forest land burned over every year by fires, that are almost wholly preventible, than are logged off for lumber. It has been estimated by a competent authority that our annual loss from forest fires amounts to $ 500,000,000."

A loss of, say a million sterling from that one source alone is alarming, but it also proves that there are still large forest areas in the United States. President Coolidge, in a recent

"warning" of the approaching exhaustion of America's forests, pointed out that there were approximately 745,000,000,000 cubic feet of timber left in the States, and against the supply there was an annual drain of 25,000,000,000 cubic feet, whilst the annual timber growth was only 6,000,000,000 cubic feet.

According to an American author, the total area of South America is estimated at about 7,700,000 square miles, out of which at least 6,000,000 square miles are entirely wood. But even allowing for improved facilities for transport and a consequent lessening of freight rates, the woods of South America are not an economic proposition for building trade work in the Old World. The United States will in time absorb all that she can get of softwoods from the North Canada, and hardwoods from the south of her possessions. The vast resources of India are a great asset to the Empire, but while there are softwoods in Europe, Indian woods such as those put on the British market of late years will be employed for furniture and decorative work. Of the five continents there is only Europe at present, and Northern Asia in the distant future, which can supply the British market with building timbers on a very large scale.

The time may come, as it came in the early days of the Great War, when we shall find that we have placed too much reliance on securing our wood supplies from overseas. In an international conflict, even though we may not be participants, our foreign and Colonial supplies of timber may suddenly be cut off. To guard ourselves against the possibility of such a contingency it is the imperative duty of Britain to plant widely and at once. To the practical "timber man" it may not be a business proposition as giving certain financial profits—neither is a fire insurance policy. The Government and the railway companies, by concessions, should encourage landowners, large and small, to plant as extensively as possible.—[*"Pioneer" Trade, Industrial and Economic Supplement.*]

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TESTING TAIL-SKIDS AT THE FOREST RESEARCH INSTITUTE, DEHRA DUN.

When the Squadron Leader, Stores Staff, Headquarters of the Royal Air Force, India, sent to Dehra Dun an enquiry as to the suitability or otherwise of Indian mulberry *(Morus sp.)*, kikar *(Acacia arabica)* and shisham *(Dalbergia Sissoo)* for aeroplane tail-skids, he suggested a problem for the solution of which, up to that time, no provision had been made in the programme of work at the Timber Testing Laboratory. It is true that the Royal Air Force have definite specifications for the quality of ash admissible for this purpose, and it would seem, at first sight, a simple matter to consult the results of routine tests on the other species of timber to see which, if any, fulfil those specifications. This is, in fact, the first step which must always be taken in the consideration of such a problem, but its completion means only that the investigation is fairly started. The Royal Air Force specifications are for *ash*, and it is evident that, with a substance so variable as wood both in physical and in mechanical properties, a species fulfilling or even surpassing the required specifications might prove unsuitable as a substitute for ash, while another of which the routine test values are somewhat inferior might prove perfectly satisfactory for the purpose under consideration. It is necessary, then, to select from the results of routine tests those species whose strength values lie near the specified values for ash, and to consider those which have somewhat less as well as those which have somewhat more strength than is required for ash, and then to devise some kind of test which will subject these timbers to practically the same kind of stresses that they will be called upon to resist in service. Tests of this kind are called "suitability tests."

A tail-skid is a small wooden part, and for the aeroplanes considered in this investigation is about 21″ long. It is pivoted on a bolt which passes through it 9″ from its larger end. The smaller end is attached to a strong shock-absorber, while the larger end touches the ground, when the plane is not in flight, supporting the tail of the aeroplane. When the aeroplane is "taking off" and when it is landing, the larger end of the tail-skid is subjected to more or less severe blows on the ground, and consequently the skid must be strong and resilient.

One method of finding substitute woods for tail-skids would be to make up trial skids from woods "believed" to be strong and try them on aeroplanes. One can, however, conceive of reasonable objections on the part of the pilot to testing a doubtful tail-skid by landing in an aeroplane to which it was fitted.

Such a "guess work" method was fortunately not necessary. There were available at the Forest Research Institute figures from the tests already made on some species of Indian timbers, and a Hatt-Turner Impact Testing Machine. The former provided a reliable means of selecting some of the timbers worth testing as tail-skids, and the latter made it possible to test actual tail-skids made of the selected species by subjecting them, in a practical way, to the same kind of stresses they would be called upon to meet when used in aeroplanes. The accompanying illustration shows how this was accomplished.

A bracket was made in which the tail-skid was pivoted on a bolt just as it would be in use. The shorter, larger end of the skid rested on the base of the testing machine, and the smaller end was clamped in a rocking support so that the whole specimen was in much the same position it would have been when the aeroplane of which it formed a part was landing. A 50 lb. weight was then dropped on to the bracket containing the pivot bolt from gradually increasing heights till the specimen was broken.

This method of testing gives a great deal more information than could possibly be obtained by simply trying experimental tail-skids in aeroplanes. All the latter method will show is whether or not certain kinds will break. With the former method a

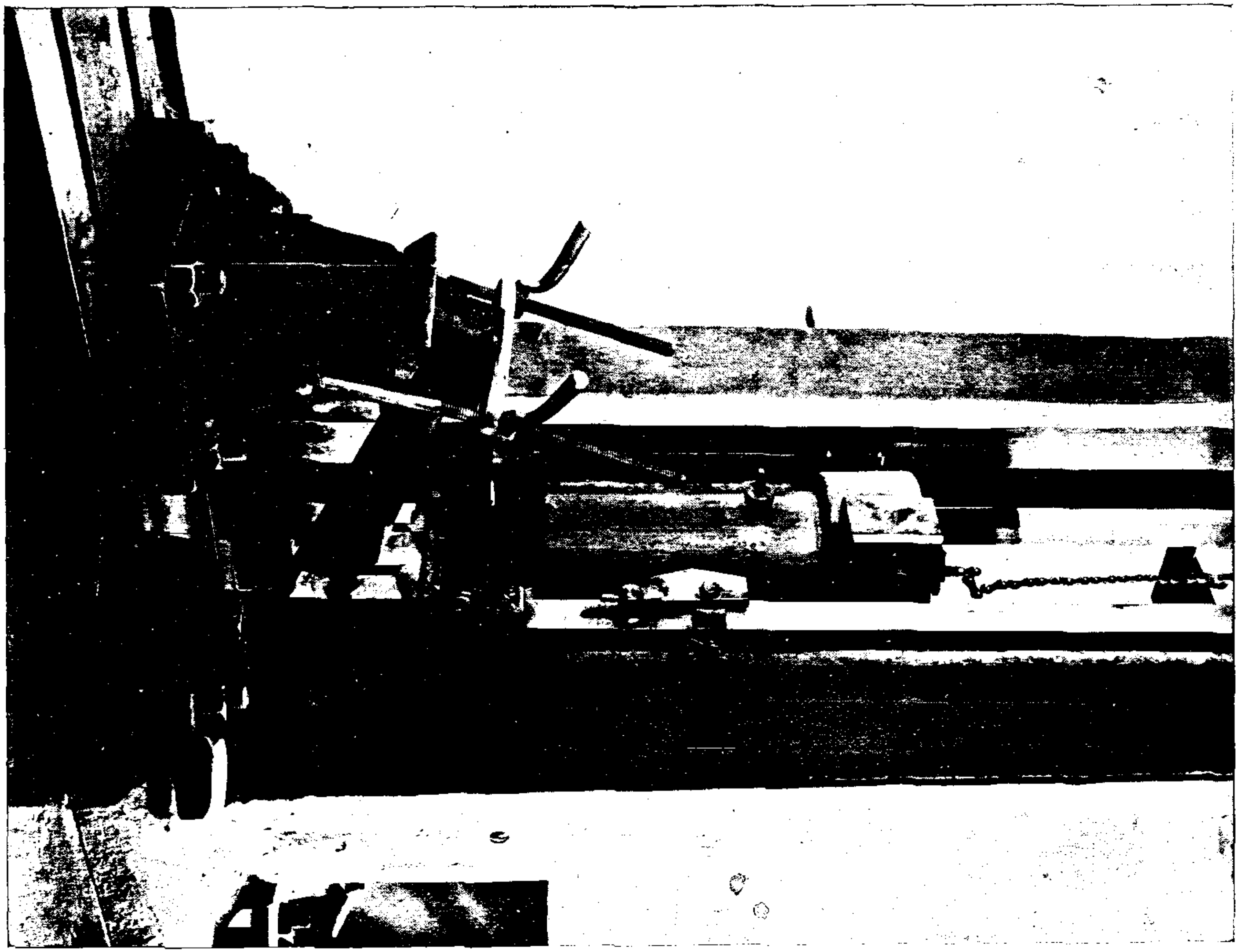

Photo by Har Swarn

record is made, by means of the pencil which can be seen projecting through the weight in the illustration, of the amount of bending the specimen suffers under each successive drop of the weight, and the springiness of the different kinds of wood can be compared. This method also indicates how much reserve of strength there is in each kind of material tried beyond what is necessary to resist breakage in use.

An examination of the records of routine tests at the Timber Testing Laboratory suggested that, in addition to the species mentioned in the enquiry, it would be well to test yon (*Anogeissus acuminata*), dhaman (*Grewia tiliaefolia*), and laurel (*Terminalia tomentosa*), and these timbers were consequently included in the study. There are doubtless others that will prove, later, to be worth investigation, but the species mentioned have already been tested, and were available at the time of the enquiry. Olive (*Olea ferruginea*) and *Parrotia Jacquemontiana* also probably have the necessary strength, but they are obtainable only in very small sizes, and so were not included. Sundri (*Heritiera minor*) was not included on account of its great weight.

The results of this study prove that at least four species of Indian wood will make excellent tail-skids. Tested under practically the same kind of stresses as those to which they are subjected in use, the timbers fall into the following order as regards their ability to resist breakage :—

Species.	Height of Drop	Weight per cubic foot of seasoned wood.
1. *Anogeissus acuminata* ...	53 inches.	57 lbs.
2. *Terminalia tomentora* ...	42 ,,	54 ,,
3. *Dalbergia Sissoo*	36 ,,	51 ,,
4. *Grewia tiliaefolia* ...	35 ,,	48 ,,
5. Ash	33 ,,	40 ,,
6. *Acacia arabica* & *Morus indica.*	27 ,,	52 45 ,,
7. *Morus alba*	19 ,,	39 ,,

It will be seen that the Indian timbers are heavier than ash, and probably could not be used as substitutes if they formed a large part of the structure of the aeroplanes. For tail-skids, however, the additional weight is immaterial. In the case of yon and laurel, moreover, the reserve of strength is so great that, except where prevented by structural considerations, the size of parts could be sufficiently reduced to bring their weight below that of ash without sacrificing necessary strength.

Although the first report on this work was submitted only in July last enquiries have already been received concerning the supply of laurel, yon and dhaman. This should be convincing proof of the value of furnishing reliable information about the strength of timber to possible consumers. As stated above, there are doubtless other species as good as, or possibly better than, those already tested, but this report relates to the material that was available at Dehra Dun when the question was raised. Normally, the Forest Economist prepares lists of timbers to be tested and asks Forest Officers in different parts of the country to supply them, but he is always anxious to receive from interested officers suggestions of suitable timbers for investigation. Yon is a case in point. This timber was suggested and test material supplied by the Utilization Conservator, Burma, about seven months before the arrival of the query concerning tail-skids, with the result that data and material were available when opportunity for their use arose. It will take many years to accumulate strength data on all the useful species of timber in India, and it is, therefore, to the advantage of Forest Officers everywhere to suggest tests on timbers of which they have quantities to dispose of, provided they have reason to believe that the timber may prove to be good.

L. N. SEAMAN,
Officer in Charge, Timber Testing Section,
Forest Research Institute.

FOREST TAXATION.

The taxation of the forests is part of the wider problem of land taxation in general, and this again is part of the ordinary general question of taxation.

Taxes are peculiar in that there is no apparent direct return for the money spent, nor is even the indirect return always proportional to the tax paid. Good government, good roads, good sanitation, an efficient army and police force, do raise the general values in a country or district, and these things have to be paid for. They may be paid for by voluntary contributions (a method which only solves the problem on rare occasions and does not last), by business undertakings on the part of the State (a method which has many objections to it), and by taxes. In most countries it is the last which provides the bulk of the revenue.

Taxes present various peculiar problems. A poor man gets almost the same advantage from an efficient postal service, good roads, etc., as a rich man, and he probably gets even greater advantage from cheap education, State hospitals, etc. Yet he pays less taxes than a rich man. This is a principle different from that usual in economic dealings. In purchasing a loaf of bread or a pound of meat the rich man gets the same value for money as the poor man.

The existing distribution of wealth in the community is extremely unequal. If taxes were absolutely proportional to income, the existing social inequalities would remain exactly as they are, and there is a view of taxation which upholds this, believing that a system of perfectly free competition tends to produce the greatest ultimate advantages. Others again, while they would like to see a more even distribution of wealth, do not consider that taxes are the best means of attaining this redistribution ; others again, knowing the inherent dislike to taxes, consider that taxes should be raised so as to cause the least friction without considering their justice.

The majority of taxation schemes do attempt to bring about a better distribution of wealth through taxes, and two main theories seem to emerge—

(*a*) That taxpayers should make the same real sacrifice. This would lead to a very high increase in the rate of taxation with increasing wealth.

(*b*) That they should pay according to their ability.

Either method carried out in its entirety would have various disadvantages, but the most important perhaps is that it would discourage the accumulation of wealth, and the whole of economic life at present is bound up with the accumulation of capital. While, however, neither theory is applied completely, applied broadly they both end in a system of progressive taxation, that is that the higher the clear net income the greater the *rate* of the tax. Obviously the cost of producing the gross income should be deducted before the taxable sum is arrived at, and though there may be much dispute as to exactly what are legitimate costs, the principle is clear enough.

While the principle of progressive taxation is simple enough, its application is not quite so simple. It is wholly based on and justified by the belief that the present distribution of wealth is unjust, and that social reform is necessary (matters which no decent-minded man denies) and that taxes are one of the methods of reform. There are arguments against this view of course, and one, at any rate, can be given, *viz.*, that as the present uneven distribution is *a result* of the existing social system and taxes only affect this result, it is better to go to the root of the matter and reform the causes.

Progressive taxation can be based on the source or kind of income. Thus the excessive profits made by the holder of a monopoly are peculiarly fit for heavy taxing, for even if taxed to the full extent of the real monopoly profit, it will not in any way discourage the industry or the accumulation of capital, and will only do so when more than the monopoly profit is taken. But while this is very simple in theory it is quite impossible in practice owing to the difficulty of distinguishing between the fair profit as payment for the peculiar ability of the monopolist, and what is the real monopoly profit.

The progressive tax can also be levied on interest derived from capital. Interest at all is justified as a spur to the accumulation of capital. But most large incomes derived from the interest on accumulated capital, enjoy a certain amount of saver's rent, that is to say they gain something over and above what is necessary to induce saving. This saver's rent can be progressively taxed without in any way discouraging accumulation.

Apart from the accepted principle of progressive taxation the following additional points are observed :—

Other things being equal, taxes should be levied which are cheap to collect, and where the proceeds of the tax are large compared with the loss it causes. Thus it would be far too expensive to collect income-tax from people with very small incomes. It requires an army of tax-inspectors and the proceeds would be small. It is also a bad principle under this head to tax an industry subject to the law of increasing returns.

The collection of the tax should not cause inconvenience to the taxpayers. People dislike taxes and there is no need to call more attention to them than is necessary. This accounts for the popularity of indirect taxes with the politician.

The taxes should not vary greatly from year to year, and the method of calculation should be simple enough for the ordinary man to grasp at once. It is this point really which causes much of the difficulty in forest taxation.

Lastly, taxes should fall far more heavily on unearned increment than on earned increment. While it may be very difficult in practice to distinguish exactly between earned and unearned increment, the principle is clear enough. If, for instance, a main high road is run between two popular centres, the land along that road will largely increase in value. This increased value has nothing to do with the owner's ability or hard work, but is simply the result of a road paid for out of the pockets of the general taxpayers. This value created by the general taxpayers obviously belongs to them, and the owner of this property of enhanced value is a very fit subject to tax to the extent of this unearned increment.

INCIDENCE OF TAXES.

The problem of taxation does not cease with the levying of the tax. The *impact* of a tax falls on the person from whom the tax is actually collected. The *incidence* of a tax falls on the person who ultimately pays. Both impact and incidence may fall on the same person, but frequently the tax shifts, and the person from whom the tax is actually collected is not the person who ultimately pays it. An example of the latter is a small tax on some article of common consumption, *e.g.*, a tax on the sale of salt. This would be collected from the seller of the salt, but it would be actually paid by the consumer of salt. A protective tariff on an imported article as a rule shifts in exactly the same way. Glib phrases like "making the foreigner pay the taxes" do not work out, and a customs duty of 30 per cent. on motor cars will be payed by the consumer of motor cars, and not by the foreign manufacturer.

A tax on persons as opposed to what they do cannot be shifted. If everyone over 21 years of old is taxed there is no way of avoiding that tax—except by lying. If, however, all lawyers were taxed, and no other calling, lawyers would tend to decrease, those left would receive higher wages, and part of the tax would thus be shifted from the lawyers to those who employed them.

Income taxes, and property taxes are both used in taxing forests. Income tax is largely in the nature of a personal tax, and falls mostly on the people taxed. A property tax, if all values are correctly calculated and assessment is correct, comes to much the same thing as an income tax, but if it is heavy enough to discourage that particular form of property, growing forests for example, then the burden will tend to fall on the consumers of timber.

The basis of most modern systems of taxation is some form of income tax and this applies equally to income derived from land whether the produce be timber or not.

Whatever the system employed it must be the same in principle for all forms of land culture. For if there is some excessive tax on land used for forests, as compared with that used for

agriculture, certain land will be driven out from forest cultivation, prices of forest produce will rise, and the consumer of timber will pay the tax intended to fall on the owner. Germany taxes forests on the basis of income. The ground tax takes a definite proportion from the net income of the soil. Where there is a normal series of age gradations and a yearly income it is comparatively easy to arrive at some basis for taxation. There are various details in the German methods which need not be elaborated, thus, upkeep of roads is deducted from income before the taxable income is reckoned, the removal of excess growing stock is not taxed, but if less than the real increment is cut the taxable portion is assessed as if the real increment had been cut.

Switzerland and Sweden, however, take a property tax as the basis of taxation, and modern opinion in the United States seems to favour a property tax rather than an income tax for forests.

As the usual principles of taxation apply to forests as much as to anything else, and as forestry flourishes in Europe under various forms of taxation, it appears that the whole problem is one of just assessment and rate of taxation rather than of method of taxation.

It is this matter of assessment which causes the difficulty. These difficulties will be indicated, but no attempt will be made to solve them in this paper. They are extremely complicated problems in forest valuation. One of the first difficulties is the distinction of capital and interest. An owner possessing a piece of bare land and deciding to grow forest on it, receiving his yield after 50 or 60 years only (intermittent yield), might with reason regard his soil as capital and his final crop as interest. If he is subject to an income tax he should pay only once in fifty years. But that would entirely upset the whole idea of taxes, for whether they be local or State taxes a yearly income is required. If then this intermittent income is converted into a yearly income there arises the complicated question of the rate per cent. to employ.

If, however, a property tax is decided upon, then the bare land value would be the first basis for the tax. Later, however, as the timber grows up, the property is re-assessed, and he pays at a

higher value. This goes on year after year, during which time he has derived no income and has continued to pay out taxes. As forest lands are sometimes assessed, it appears that the compound interest charges on these past taxes may swallow so much of the final crop value that it largely discourages forestry.

A further proposal in America is to have a combined tax, part a yearly tax for budget purposes and part a yield tax when the crop is felled. Here again, however, various difficulties and complications arise in valuation.

The latest American opinion deprecates any idea of special benefits for forest owners—and quite rightly—but urges that the methods of assessing forest values be revised so that the burden falls fairly.

The special difficulties of forest taxation are concerned solely with the peculiar difficulties of forest valuation. A fair and correct method of valuation has to be evolved, and it must be simple enough for the ordinary tax assessor to apply.

Having stated the problem, I leave someone else to solve it.

C.

EXTRACTS.

RECENT PROGRESS IN INDIAN FORESTRY.

An interesting lecture was recently delivered by Professor Stebbing in London on November 20th, 1925, before the Royal Society of Arts on "Recent Progress in Indian Forestry." Professor Stebbing joined the Indian Forest Department in 1893 from Coopers Hill, at the same time as Messrs. Perrée, Billson, Smales and Tireman, among others, and retired in 1914. Since then he has been Professor of Forestry at Edinburgh University.

Lieut-Col. Sir David Prain, I.M.S., C.M.G., C.I.E., LL.D., F.R.S., in the Chair.

The Chairman said that some who were present that evening might have had the opportunity of reading the striking impressionist sketch by Professor Stebbing, which appeared in the Jubilee number of the *Indian Forester* of the present year, and those who had read it would look forward with pleasure to the filling up of the picture of which that was an outline; and those who had not read the article would have that evening the advantage of hearing an account of Mr. Stebbing's visit to India.

The paper read was:—

RECENT PROGRESS IN INDIAN FORESTRY.

BY PROFESSOR E. P. STEBBING, M.A., F.L.S.

In March, 1910, a paper on "Indian State Forestry," by Sir Sainthill Eardley Wilmot, K.C.I.E., was read before this Society. Other papers* dealing with the subject have been presented both

* Col. A. R. Wragge, 'Indian Forests and Railways' (1871); Sir Richard Temple, Bart., 'Forest Conservancy in India' (1881); Sir W. Schlich, 'The Utility of Forests and the Study of Forestry' (1890); Mr. R. S. Pearson, C.I.E., 'The Recent Industrial and Economic Development of Indian Forest Products' (1917); Prof. R. S. Troup, C.I.E., 'Indian Timbers' (1921); Mr. A. L. Howard, 'The Timbers of India and Burma' from a commercial point of view (1922).

before and since, and are recorded in the Society's Journal. Nearly 16 years have elapsed since Eardley Wilmot's paper was written—years which have witnessed great progress in Indian Forestry.

Eardley Wilmot referred to the inauguration of the Forest Research Institute at Dehra Dun. He was the founder of the Institute in 1906, having obtained the support of that clear-visioned and most able Administrator and Viceroy, the late Lord Curzon. To the foundation of the Research Institute and to the work done by some able Research Officers, entirely drawn from the Forest Department at the outset, may be attributed much of the professional and technical advance made by the Department in the last decade. And curiously enough, the Great War, by leaving India to a great extent dependent on her own resources, materially assisted in the progress. But it would be invidious and unfair to credit the advance solely to these causes. There were able men in the Department before the advent of the Research Institute, men who observed and experimented, though unfortunately the records of many of their investigations were never committed to paper. But the accumulating effect of this work was there and the clever brains of a later generation seized upon and classified the information which existed and, as I hope to show, the results in a few short years have placed the Department, in some respects and in some localities, in a position professionally second to no other in the world.

I have been engaged upon a history of the Indian Forests for the past six years and to this fortunate though arduous undertaking I owe it that, with the aid of and at the invitation of the Government of India, I was able to re-visit India this year, go round the provinces and see for myself something of this wonderful progress. I re-visited many places I was previously acquainted with, and I propose to endeavour to place before you something of what I saw. I realise the difficulties of this task. The country we know is large and the forests widely distributed. I saw instances of remarkable, at times almost unbelievable, progress in every Province, and my space in one short paper is restricted.

In view of the record of the past in the *Journal* of the Society my remarks will be confined to recent progress. For those interested in historical development it may be suggested that this progress dates from the advent of the Research Institute, and holding that belief I propose to glance briefly at its activities in the first instance.

The Institute sanctioned, Eardley Wilmot selected the officers to fill the posts from the Department, the posts being Silviculturist, Superintendent of Working Plans (subsequently abolished), Forest Botanist, Forest Zoologist, Economist and Forest Chemist. Later, pulp and tan experts were appointed on short contracts. The old Forest School was given the status of a College and the research officers were required to give courses to the classes in their special branches. The difficulties encountered at the start were the unavoidable ones of an almost total absence of accommodation and small staffs. Forest Botany was well housed, but the rest had to make do with very inadequate quarters. The chief work undertaken in all branches during the first few years, in addition to touring and a certain amount of investigation, was connected with the collection of statistics and data scattered about the country in reports, memoranda and so forth, and opening out ledger files. Experimental work was carried out in Silviculture, botanical investigations were undertaken, as also insect investigation work, and the Economist and Forest Chemist, working under extreme limitations, commenced investigations and experiments which in the case of the former were to lead to an extraordinary development. During these years Mr. L. Mercer, C.I.E., was President and building was carried on, but it was not till 1913 that the Forest Institute building was opened, it being considered at the time that ample provision in accommodation had thus been made for at least 20 years. The Institute grounds covered an area of 47 acres; the cost of the land amounted to R. 1,68,000. In addition to the main building, ample and fully-equipped laboratories and workshops for the Economist and Chemist and an Insectary were erected in the grounds, as well as students' quarters to house the recruits under training for the Provincial Forest Service. The total outlay amounted to

Rs. 5,08,000. The main block, in addition to providing offices class-rooms, etc., contained the Museums of the Silviculturist Economist, and Forest Zoologist. The building and its arrangement were probably the finest to be found in the East. A year after the opening the Great War burst on the World. The forces upon the Eastern Fronts in Mesopotamia, Egypt, Salonika, Aden, East Africa and Persian Gulf Ports had very soon to depend mainly upon India for their requirements, and the Forest Department was faced with heavy and urgent demands for timber, fodder, and other produce. Calls were made upon the Institute, especially on the Economist Branch. Many timbers were being utilised which had been unmarketable before, and a great impetus was given to experimental research in many directions. The heavy initial work of the first few years in the collection of existing material and statistics now bore fruit. The Government of India had become fully alive to the remarkable development which was taking place and to their indebtedness to the Institute for the work carried out during the War. It had already outgrown in all branches the building opened in 1913, but more especially so in the Economic Branch. The great and increasing value of this branch made a readier appeal, the financial one, to the non-forestry expert, but it had fully earned the high praise accorded it. In 1918 the position was reviewed, and schemes were developed for enlarging the Institute and approved early in 1919 at the Triennial Conference of Conservators from all Provinces. The staff was to be considerably increased. The ground available in the existing Institute was not sufficient for expansion on any large scale, nor could an adequate area to allow for future extension be secured in the vicinity. A far larger scheme received the sanction of Government. A new Research Institute building was to be erected. For this purpose and to allow for all probable future expansion an area of about 1,300 acres a few miles outside Dehra was acquired at a cost of R. 12,82,000. The new Institute building with the necessary workshops, laboratories, officers' quarters and those of the subordinate establishment, was estimated to cost a sum of Rs. 1½ crores. The most urgent part of the programme was the erection

of the Economic workshops and laboratories with quarters for the connected staff, since the work of this branch was being hampered for the want of up-to-date plant. This part of the new Institute has been erected at a cost of Rs. 22,33,000 and Rs. 5,22,000 have been expended on the equipment. One wing of the new main building is under construction. It will be seen that the new Institute is cast in a giant mould. The Inchcape Retrenchment Committee, who found themselves unable to sympathise with the expansion, considering that some of the research work could be left to private enterprise, although nothing in the previous history of the Department lent colour to this idea, advised considerable cuts in the sanctioned expenditure. The building programme was put on a 3 year block grant, which fortunately did not interfere with the more important work, and it is understood that more far-seeing councils have prevailed and there is every hope that the original programme will be carried out. India will then be in possession of not only the finest Forest Research Institute in the East, but it will be unrivalled in the world.

A few words upon the work of the Branches. They must be regrettably brief. Triennial programmes of the work to be carried out are now prepared.

The officer who really started the work of the *Silvicultural Branch* in 1909 was Mr. Troup, now Professor of Forestry at Oxford. His predecessors had been Messrs. Hobart Hampden, J. H. Lace, C.I.E., and A. M. Caccia, C.B. Caccia was the first Superintendent of Working Plans and carried out some good work. The combination of the two posts for a short time was not a success. Troup set to work and with painstaking patience collected the mass of information in existence, but unutilizable in its then form, and sorted and filed it for future use. He carried out tours throughout the country, instituted series of sample plots for ascertaining the rate of growth, etc., of different species, undertook research into the germination of some valuable species and, even more important, advised local forest officers in matters dealing with the silvicultural management of the crops with the

object of introducing more advanced methods and the replacing of the old selection system by systems admitting of more intensive management. Troup was instrumental in introducing in some localities the concentrated method of regeneration by *toungya*, the Burmese term for shifting cultivation, which will be alluded to later in this paper. He compiled, as a result of his work, his valuable *Silviculture of Indian Trees.* Mr. Marsden followed Troup and concentrated his attention on collecting statistical data on rates of growth from divisional records. An outcome of the work may have been said to be the first Silvicultural Conference which met at Dehra in 1918, at which methods of collecting future data were standardized. The present Silviculturist, Mr. Howard, has been engaged, together with local silvicultural officers appointed in the provinces, notably Messrs. Trevor, Conservator of Working Plans, and Smythies in North India, in preparing statistical tables of yield from species such as sal, deodar, and *Pinus longifolia*, whilst Maitland in the Central Provinces has prepared a sal and teak volume table, and Blanford, Conservator of Working Plans in Burma, rough tables for teak, pyinkado, *Dipterocarpus tuberculatus* and *Terminalia tomentosa* for certain localities. The value of the work which has resulted in the application of silviculture to the Working Plan is incalculable, and its effects can be seen in certain localities throughout India at the present day; and we have object lessons in the practice of forestry, few as yet, but present, comparable to the best to be seen in Continental Europe. The fine photographic branch of the Institute is under the Silviculturist.

The work of the *Forest Botanist* was under Mr. Hole from the start to 1924. The work accomplished falls under four heads: (1) Education. Hole published a Botany Manual which was favourably commented upon by Sir David Prain. (2) Systematic Botany. The object was to disseminate as widely as possible amongst forest officers a good knowledge of the names and economic uses of forest species, firstly, by encouraging the publication of floras and descriptive lists, and secondly, by identifying specimens from enquirers. A flora has recently been published for the Punjab and descriptive lists for the Central Provinces. It was

recognised that a good botanical library and a good herbarium were necessary. Since 1908 more than 20,000 sheets have been added to the herbarium in addition to Mr. Duthie's valuable Saharanpur herbarium incorporated in 1908. (3) Diseases of Trees. Considerable work on soil aeration in relation to root diseases was carried out. (4) Oecology. Under this head work was undertaken by Hole on soil aeration as a factor influencing the growth of plants, especially sal. A large series of experiments were carried out with sal, especially in connection with the factors influencing the growth of seedlings. Mr. R. N. Parker, who is now in charge, has been chiefly occupied with the herbarium. In 1925 there were nearly 40,000 sheets in the herbarium of which 18,000 have been collected in the last four years. Mr. Parker rightly deplores that no Mycologist has yet been appointed to the branch and that its staff has never been equal to the work to be carried out.

The post of *Zoologist* or *Entomologist* is the oldest of the research posts, since it was first inaugurated in 1900. After several years of pioneer work, Dr. Imms was appointed to the post and progress developed on three main lines—a reference collection of insects, a reference library and adequate laboratory and insectary equipment. Imms also carried out research on lac (*Tachardia lacca*) and the *Pinus longifolia* scale (*Ripersia resinophila*). Dr Beeson was appointed when Imms resigned, and he had the good fortune to commence work in the new Research building with well-equipped laboratory and insectary. His work has been primarily directed towards an extensive survey of forest insects from an œcological standpoint. He has carried out successful work in combating attacks of pests such as the sal heart-wood borer (*Hoplocerambyx spinicornis*), the beehole borer of teak (*Duomitus ceramicus*), and so forth. The post of Systematic Entomologist in the branch has been filled by Dr. M. Cameron and Mr. J. C. M. Gardner.

In the *Chemistry Branch* work of considerable value has been carried out, especially after 1914, when sufficient laboratory equipment became available. The demand for analytical work steadily

increased at the expense of the possibility of undertaking original work. A certain amount of investigation work was put through with the object of demonstrating the possibilities or otherwise of developing certain industries on a commerical scale. The branches of necessity closely associated with the Economic Branch. Investigations carried out have been into Tanning extracts, distillation of turpentine from the resins of Indian pines, the possibilities of Pine needle oil, the chemical properties of the natural varnish, *Melanorrhœa usitata*, which have been proved identical with Japanese lacquer varnish; the first researches into the manufacture of Thymol from "Ajowain" seeds were made at the Institute, and have resulted in the erection of a factory in the Dun which supplies a large part of the World's requirements. Mr. Puran Singh was the first Forest Chemist. Under the reorganisation Dr. Simonsen was appointed in 1919 and held the post till 1925.

Lastly we come to the *Economic Branch.* Almost from the start (Troup held the post for 2 years) this branch has been under Mr. R. S. Pearson, C.I.E., a son of Colonel Pearson, one of the pioneers of the Forest Department. The growth of the Economic branch is due to Pearson, backed up by the Presidents, Messrs. Mercer and B. B. Osmaston, followed by Mr. W. F. Perrée, C.I.E., the able President who carried through the great schemes for the new Institute. Both Perrée and Pearson saw the erection of the new Economic buildings on the new site and saw them all functioning before both left India this year.

In the space of this article it is a difficult feat to portray the growth of the branch. From a small shed in the compound of the old Forest School, where Pearson carried out his first experiments in wood preservation, there are now in existence perhaps the finest Research buildings and plant in the world. The growth to the present dimensions has been due to a correct analysis of the lines upon which research should proceed. There are three stages. The first is the purely scientific enquiry, usually ending in the laboratory stage. The second involves an inventory in the forest to ensure the maintenance of the supply of raw

material, together with the manufacture on a scale sufficient to test the market value and suitability of the materials or products in question. If this fails to establish a demand, the third stage, comprising the erection of pioneer plant or factories, will be necessary. The research now being carried out aims at the first, and in certain directions, *e.g.*, paper pulp, the second stage. As in the case of the other branches classification of records already in existence was commenced in Record files. In 1909 the post of Reporter on Economic Products to the Government of India was abolished, and the records dealing with forest products, collected by Sir George Watt and his successors, were transferred to the Economist's office. He had also the "Dictionary of Economic Products," Gamble's "Manual of Indian Timbers" and other reference works to refer to; also a nucleus collection of timbers and minor products at the Forest College. The first years were passed in the initial work and in the wood preservation experiments. An enquiry into possible matchwoods had already been undertaken by Troup. The utilisation of bamboos for paper pulp followed and Mr. W. Raitt, an expert, was obtained from home. The scope of the sleeper enquiry was developed and many other enquiries followed. It became recognised that the branch would have to be split up into several sections. In the 1913 building two large Museums were allotted to the branch, the workshops consisting of a Timber Testing Workshop, an experimental timber treating plant (open tank method) and storage rooms. Later a small wood workshop and a seasoning kiln were added. The difficulties at this time were to get the right type of machinery and the necessary experts. These difficulties were surmounted and the buildings, etc., now in full working order at the new site, consist of the following:—The latest type in log ponds leads into the sawmill where the logs are broken down and cut roughly into the dimensions required for the experimental work in the various branches. Next come the seasoning kilns where the experimental seasoning of various types and grades of material is undertaken in either a Sturtevant or Tiemann kiln. This section is under Mr. Fitzgerald.

Mr. Raitt is in charge of the paper pulp section. A plant has been set up which is capable of demonstrating the whole process of paper making, and Mr. Raitt, as a result of much patient work, has at length discovered the secret of producing a good paper from bamboos. Experiments with various grasses have also been undertaken in which Hole collaborated. The wood preservation plant is under Mr. J. H. Warr. Here important investigations in connection with impregnating sleepers of various timber species are being carried out. As a result of the work accomplished in this section, the N. W. Railway have erected a large sleeper treatment plant at Dhilwan on the Beas River for *Pinus longifolia* and other species. The durability tests on the pine sleepers have proved to the Railways the possibilities of this timber. Other plains forest timbers are being similarly treated and tested in the section. The section of Timber Testing is under Major L. N. Seaman, B.Sc., M.E.I.C., from the McGill University. This is indisputably the finest timber testing laboratory in the East and is fitted with a variety of machines from compression to impact. Eighteen foot beams for constructional purposes can be tested in this laboratory. Lastly, the wood workshop is under Mr. W. Nagle, an expert in his own line. Here the specimens are prepared for the various sections, over 100 a day being turned out for the timber testing section alone. The section is engaged in preparing panels of 5-ply and 7-ply wood of different Indian species for panelling the Legislative Assembly Hall at New Delhi; I saw some magnificent panels already finished. In Minor Products some good work was undertaken for a time by Mr. W. A. Robertson. Owing to lack of funds the post is vacant. The Research work to be undertaken in this branch should be of incalculable value.

The following will most fittingly illustrate the work of this branch without further comment on my part. I travelled home with Sir Clement Hindley, Chief Commissioner of Railways in India. The Railways in the past have not always seen eye to eye with the Forest Department over sleeper matters. I had several talks with Sir Clement, and before he returned to India he kindly

wrote me a Memorandum (dated September 1925), on the Research Institute. I give the following extracts:—" The Forest Research Institute at Dehra Dun has already rendered services of supreme importance to the Railways of India, but there is still a vast field of work to be covered, and there is in fact in the nature of the work no possibility of its ever being finished or completed. We are perhaps only at the beginning of the methodical and systematic work which is continuously necessary if the Railways are to secure the best available material at prices which can be regarded as commercially profitable. This is one of the problems which a commercial concern like a railway has ever before it, but it is a problem which has become accentuated by the rise of costs in all directions and the consequent need for economy. It is also a problem which, like others relating to economical working, has become more prominent by reason of the recent separation of railway finances from the general finances of the country, whereby the onus of producing an adequate return on invested capital has been laid on the Railway Board. The Railways require an organisation which will conduct investigations on scientific principles into the physical characteristics of available timbers and into the sources of supply. These investigations must be done by standardized methods and essentially co-related with the class of work required from material. The results of such investigations must be put at the disposal of every engineer and every purchasing officer, and in a form which is capable of appreciation by those who are to some extent in ignorance of the scientific side of the subject. Ignorance of the sources of supply of available and suitable timbers, ignorance of the physical characteristics of available species, and perhaps ignorance of the need for research, have been the direct cause of unnecessary recurring costs and the extension of the use of artificial and expensive substitutes. With an abundant supply of timbers of innumerable species all round us, we have hitherto confined ourselves practically to the use of teak, deodar and sal, with the result that scarcity and high prices have confronted us on many occasions.

" With the Research Institute working for us and giving us

scientific results of real commercial value, we can look forward to an extension of the use of timbers and an enlargement of the species made available for railway work."......

"It is hardly too much to say that the potential value of the Institute to the railways is so great that, if it were not in existence, those responsible for the administration of the railways on commercial lines would have to create some such organisation to 'take care' of the scientific side of timber treatment and use."

It should be pointed out that the coming of the Research Institute and the work it has been engaged upon would not in itself have enabled the Department to profit, had not a more generous financial policy been exercised during the present century. Re-organizations of the staff have taken place, and money has been made available for road construction and other extraction works. With the increase in work owing to more intensive management of the forest areas, forest circles have been split up and, to a greater degree, forest divisions have been divided and sub-divided. Instead of the 18 Conservator of Forests posts which existed in 1901, there are to-day 36; of the 36 Conservators five are Conservators of Working Plans or Utilization. In addition there are six Chief Conservators, the only Provinces without one being Bengal, Assam, and Bihar and Orissa. These officers act as Advisers to the Local Governments. The staffs of Deputy and Assistant Conservators, as also Provincial Service officers, have been greatly augmented. The Subordinate staff has also of necessity largely increased--though one often heard out in India that the Ranger class, the backbone of the Divisional Officer staff, was sadly deficient in some parts. Most provinces have also Silvicultural Research Officers who work in conjunction with the Research Institute Silviculturist.

A few remarks must be made about fire-protection of the forests. In no other branch of forest administration in India have opinions so changed as on this momentous question. It almost amounts to a revolution. Before the close of last century a brilliant forest officer in Burma, H. Slade, first questioned the correctness of the practice of indiscriminate fire protection for all

classes of teak forest. From the Inspector-General downwards the idea was treated with scorn. It may be stated at once that incalculable direct and indirect benefits have resulted from fire-protecting the forests. Owing to the steady support given by the Government in this matter, it is probable that the people became the sooner educated to respect the Reserved Forests, and large areas of forests have enormously benefited by half a century of protection. Slade's query was taken up by a few forest officers, and it had relation not to the forest as a whole, but to a certain type of moist teak forest. The first result in Burma was a stiffening of the attitude of the authorities, the area protected rising between 1897 and 1907 from 1,856 square miles to 8,153 square miles. In 1905 Troup in Tharrawaddy carried out some enumerations which seemed to show that the younger teak age classes were more numerous in burnt areas of teak forest than within the protected areas. Beadon Bryant, the Chief Conservator in Burma, took up the matter and drafted a memorandum, in which he suggested that fire protection should be abandoned in a certain type of moist forest. The Inspector-General was unable to agree that the proposals should be brought into force at once, but advised that experiments should be carried out in each circle or division. This suggestion was adopted. By 1911-12 the area fire-protected had dropped to 6,750 square miles. After the lapse of a few years the general opinion of Burma forest officers was that fire protection in the moist forests, owing to the dense growth of evergreen shrubs, soft wooded species, etc., which grew up preventing the young teak from developing, was a mistake. After a visit the Inspector-General, Sir George Hart, recommended relaxation in fire protection. In 1913-14, 4,548 square miles were protected at a total cost of Rs. 200,583. By 1923-24 the area protected had fallen to 142 square miles, at a cost of Rs. 16,731. The present policy is generally to confine protection to regeneration areas and to areas where it is known to be beneficial and financially justifiable. The Burma observations resulted in officers in the moist *sal* forests of Assam and Eastern Bengal (Duars) studying the matter, and

much the same conclusions were arrived at. In areas long fire-protected there was a dearth of the younger age classes, whilst the floor of the forest had become covered with a dense and worthless evergreen growth. The matter, in another form, spread throughout India. During recent years the method of early burning of forest areas in which the fire would cause little damage has been introduced, thus reducing the area actually protected. Its advocates maintain that unless protection from fire can be completely assured and the expense of such protection be justified, it is better to fire the areas departmentally early in the season as soon as the grass, etc., is dry enough to burn than to risk the forest being burnt in the hot weather when the fire is much more severe and the probability of damage greater. In their last two quinquennia Reviews, between 1909-10 and 1918-19, the Government of India have been, perhaps naturally, somewhat guarded in their remarks on the new departure, cautioning the forest officer against entering too light-heartedly upon the new procedure, which thus rids him of one of his most arduous duties in the hot weather. To date it may be certainly said that the Department has not needed the caution, and, so far, the departure, where it has been carried out, appears to be meeting with success. Further, it may prove a possible aid to silviculture and the regeneration of certain types of forest. I should like to have considered this most interesting question at greater length, but space precludes the possibility. It will, however, crop up in my remarks upon the work in the Provinces, to which we will now turn. I will take them in the order of my tour this year.

[*To be continued.*]

BAMBOO PULP.

(*The World's Paper Trade Review, Vol.* 84, *No.* 19, *London,* 1925, *page* 1464.)

TRIBUTE TO THE WORK OF MR. W. RAITT.

A fine tribute to the valuable research work carried on so patiently and persistently by Mr. W. Raitt, Cellulose Expert to the

Government of India, appeared in the issue of *Capital*, a weekly journal published in Calcutta.

" In bringing bamboo pulp manufacture to its present stage of development," says the writer, " no expert has shown more skill or persistence than Mr. W. Raitt, F.C.S., M.I. Chem. E., whose investigations are summar'sed in a pamphlet issued by the Forest Department concurrently with the report of the Tariff Board. In a preface to a detailed and illustrated analysis of experiments prolonged over some years, Mr. R. S. Pearson, Forest Economist at the Dehra Dun Institute, recalls that in 1919-20, far reaching schemes were being considered to extend the laboratories and workshop of the Economic Branch of the Forest Research Institute, and so struck were the authorities with the work Mr. Raitt carried out on the bamboo pulp investigation, that they sanctioned an outlay of £12,500 for acquisition of a large sized experimental plant. Mr. Raitt has now had the plant, which he describes in this record, working for about a year, and has tested in it several species of bamboo, as well as sabai grass. The results obtained not only confirm his laboratory work, but actually give better results than were anticipated. In Mr. Pearson's considered and expert judgment, the results not only mean a revolution in the methods of dealing with grasses of the sabai type, but at once bring the utilisation of bamboo for paper pulp on to an absolutely sound foundation. The above assertions are corroborated by the fact that the large paper mills of India are now adapting their plant to the fractional digestion system. Mr. Raitt and his associates have achieved results which, in the evolution of the paper industry, will be reckoned fundamental and historic. It remains to concert measures to ensure a full unfolding and exploitation of the very considerable economic developments made possible by the researches and experiments standing to the credit of a very able official."—[*Capital.*]

MESSRS. HOWARD BROS. AND INDIAN TIMBERS.

DECORATIVE WOODS.

In our issue of 12th September, we gladly published the letter of Messrs. W. W. Howard Bros. and Co. in which exception was taken to a remark in our article on the subject of Indian woods for decorative woodwork in the United Kingdom. But before making any comments, we referred to our correspondent for confirmation of the incident which led to the remark in question. The incident he confirms and we shall allude to it again presently; in the meanwhile we regret that from the single occurrence it should have been assumed that of recent times little had apparently been done to place Indian woods for decorative work upon the market. The subject is one in which we have taken an interest in the past, and on several occasions we have brought the very beautiful timbers of India and Burma to notice, as well as the good work done by Messrs. Howard Bros. in connection with them. We are glad to find from the information now given us that that work continues, and that Messrs. Howard Bros., as agents for the sale of Indian timbers, have displayed great activity. The book they have kindly sent us is a catalogue of India and Burma forestry and timber exhibits at Wembley. It opens with an extract from a paper read by Mr. Alexander L. Howard before the East India Association on 14th April 1924, and in May of that year we referred to his interesting lecture and said that Mr. Howard had done good service in bringing the matter again before the public. We notice, however, that he said at that time that there were many difficulties in the way of placing unfamiliar timbers on the market, because anything new was viewed with suspicion, and that in a number of instances there had been more trouble of late in assuring supplies than in finding a demand. We may, perhaps, be forgiven if we understood from these remarks something of the difficulty that our correspondent experienced. He disclaims the statement made in Messrs. Howard Bros.' letter that he "must have been exceedingly easily put off by the reply which he states he received." He applied to a firm of reputation from which he had received very satisfactory treatment in the

past with the result mentioned. He was not easily put off, and in subsequent correspondence he learnt that his wishes could be met, but at a higher price than if mahogany were used. He ultimately decided not to accept the higher estimate, and this seems to agree with Messrs. Howard Bros.' remark that there are certain objections to the Indian woods, because in price they do not always compare favourably with supplies from elsewhere. The point is not unimportant,—individuals have limited purses in these hard days ; they are not in the same position as those who order woodwork for the purposes of banks and other wealthy institutions ; they have to study their pockets, and if the Indian woods are a good deal more expensive than a good wood like mahogany, they have to do without them. We are pleased, however, to note from the catalogue that Indian woods are now being used freely for important buildings in the United Kingdom, and feel sure that Messrs. Howard Bros. are using every possible means to popularise the use of these timbers. In that endeavour they have our best of wishes. [*Indian Engineering.*]

FURNITURE TIMBERS OF INDIA AND BURMA.

MR. A. L. HOWARD ON THE IMPORTANCE OF USING ONLY THE BEST AND MOST DURABLE WOODS.

Mr. A. L. Howard (Messrs. W. W. Howard Bros. & Co., 38 Trinity Square, E. C. 3) delivered an interesting lecture on "Furniture Timbers of India and Burma" at the Geffrye Museum Kingsland Road, London, recently.

Mr. Howard said : The artist, sculptor or craftsman, however inspired his work or great his genius, yet depends upon the quality of the materials in which he works if his productions are to go down to posterity to remain as monuments of the era in which he lived. There is little doubt that a great number of beautiful works have gone altogether because the colours in which the artist worked, or the stone or marble or wood was not durable. In no work does this principle apply more than in the finest artistic woodwork. We in Europe owe a great part of our artistic

sense, our knowledge of what is beautiful, and our monuments, to the Renaissance—a movement dating about the thirteenth and fourteenth century, and which originated in Italy. Nearly all, if not all, of the executed wood work there - furniture, panelling, the carved screens and stalls of the churches and cathedrals—has entirely gone, not because of any failure on the part of the artists who designed, or the craftsmen who executed the work, but because they always worked in European walnut, a wood sure to be destroyed by beetle within a comparatively short time. When I visited the cathedrals and churches in Venice, where for richness of detail, beauty of design and excellence of craftsmanship it would be impossible to excel the work made, only patches of it could be seen, the rest having crumbled away into dust as the result of attack of beetle.

We may start with an earlier period than that of the Renaissance. We have examples of early British work in oak, cherry, yew and elm. For durability yew and cherry are fairly good, oak not too good, but elm is bad. The design was crude, uninteresting, and, except for antiquity, of little interest. For panelling, carved screens and choir stalls, oak is admirable, and the highly satisfactory conditions of such work in cathedrals and churches in Northern France and England remain and assert the superiority of the wood over the walnut of Italy. It is interesting to note that we learn that in the dignified and romantic choir stalls of the cathedral at Amiens, one side was carved and the wood supplied by a rich man who could afford to pay for the finest timber, while the other side was carved and supplied by a poor man, who could not buy such good material. The workmanship in each case is equal, but the better quality of timber used by the rich man is apparent. In this cathedral there are some small pillars about $1\frac{3}{4}$ inch square and perhaps 27 inches long, where the wood is cut through, leaving four strands of about $\frac{3}{16}$ inch thickness or less which are perfectly sound and which when twanged, as one would twang the string of a violin, produce a similar note.

The Age of Mahogany.—Leaving the age of oak, we come to that of mahogany, with the well-known Chippendale style (which

perhaps ought to be called Wollaston and Chippendale) coming into vogue. Chippendale worked almost without exception in the finest quality of mahogany which could be got, always or nearly always solid, and generally plain in character, without figure. The prominence and value to-day of these beautiful works are largely due to the excellence of his choice of wood. I must not dwell too long upon varying styles, but would like to mention Sheraton, Hepplewhite and the Adam Bros., who in practically every case, whether they worked in mahogony, in sabicu or in satinwood, or all three together, or even where they introduced some inlay or banding of other woods, used timber of the very finest quality. Sure it is that these artists were not only great in their art, but knew the qualities of timber in an unusual degree. With the age of William and Mary, and the Early Victorian period, a lot of rubbish began to be produced, and the magnificent veneered work previously made was followed by the most inferior stuff, so that the furniture which was veneered began to get a bad name, and its reputation was finished by Charles Dickens. Everyone will remember Mr. Veneering, of the firm of Chicksey, Veneering and Stobbles, where R. Wilfer was employed. Under the ruthless pen of Dickens the perfect sham of society was illustrated by this reference to veneered furniture. So ignorant and careless is the British public that the fact that there existed a period when veneered work was made badly is still remembered, and even to-day there are those who demand solid furniture, and say they will have none of the "veneered rubbish," not that solid furniture is desirable, and only a moderate amount of intelligence is required to discover that for certain styles and purposes solid woodwork is best, while for others, especially if fine figured work has to be used, there is only one way, that being to veneer it, and abundant evidence exists that properly made veneered work is as good and as durable as any.

Good Material Essential.—I have shown now, I hope clearly, that the choice of good material is essential, and in this choice we have to-day, especially in England, a large table and a rich banquet. We in this country are the most extravagant users of

timbers the world over, principally because we allow our stupid prejudices to guide us, rather than sound sense and good judgment. I have seen references made in the press to remarks of cabinet ministers that the highest standard of living is to be found in England: certainly the highest standard of woodwork is to be found here. The question is, whether we can afford to continue it. One is astounded to see the kinds of wood which are used in France, Belgium, Germany, Austria and Hungary. In these countries the economical use of timbers is studied and practised in a far greater degree than it is here; for instance, on a visit to Austria and Hungary in 1914, I found beech almost the highest quality used in furniture everywhere; in woodwork in the houses elm is very largely employed, and in floorings and panelling those portions of the timber which contained sound knots and other defects, which we burn, are used. Again, in England people remain satisfied with timbers bearing the "sacred" names of mahogany, walnut and oak, while in France at least 30 or more different sorts are continually in use. Because certain kinds of wood were named in specifications, five, ten or fifteen years ago, their use is continued here without the slightest reference to whether a more economical wood might not be obtained, and, indeed, sometimes without even actually correctly naming the timber required. Thus, for instance, what is known as American whitewood was, when first introduced called basswood, and is so called in Scotland to-day, and was looked at askance; at that time it was obtainable at about 2*s.* per foot cube, while now it costs about 6*s.* to 10*s* ; then it should have been used more extensively, now its use should be excluded altogether, American whitewood is a valuable timber, easy to work and can be obtained in wide widths and sound quality, but it possesses no particular merit which makes it a necessity. The same applies to American black walnut. Thirty years ago perfect boards, free from fault, up to 30 inches wide, were obtainable at 6*s.* per foot cube, and people would not buy it; to-day, when on account of scarcity of supplies American black walnut is practically cut out, it is hard to get wood up to 12 inches wide, and the buyer has to take two or three or more inches of sapwood, which has been darkened by a process of steaming, even at a cost of 15*s.* to

24*s.* per foot cube. British railway companies, public departments of Government, and others insist upon having it. Look at our present terrible debt to America, and ask yourselves whether we can afford to pile it up still higher? Do people realise that this is at present no less than £800,000,000 sterling? While this is hanging over us, were I the director of a large concern or a public department, I would rather buy British-grown beech and stain it, if I could not find something better, and, what is more, the beech would look quite as good. Unfortunately, not only does the cost of the wood itself have to go to America, but the cost of all the labour in sawing, railway and sea-freight, which, if the money were paid within this country, would help our unemployment, as well as our financial condition. At any rate, such timber should not be purchased unless a sufficient price be paid for our at present free market.

Empire Timbers.—All around you are specimens of great variety of all the new India and Burma timbers. Four years ago these timbers were not obtainable; now they are to be had in large quantities. You will see that for variety of colour and richness of tone it would be impossible to surpass them. There is also a wide range in the quality of the grain. From what may be described as a relatively soft and easily-worked timber, up to hard, and perhaps the hardest, all classes are included. We have had to endeavour to overcome a great number of obstacles in the introduction of these woods, one of these being that a report has been put about that the timbers were hard to work, another that they were liable to split. The report about them being hard to work is nonsense. Primitive man used fire as a means to hollowing his boat from the tree trunk. Metals were discovered, forged and brought into use, and craftsmen developed in their various industries tools made of steel, hard enough to deal with all classes of material however hard, so that the hardness of the wood becomes merely a question for the machine, and does not effect the worker. The general practice in workshops to-day is to give the material to the worker, sawn, planed and squared. What he has to do is the fitting, finishing and cleaning off or surfacing, and many very

hard woods are easier to finish off than many of the soft ones. I am told that one of the hardest tests which can be given to a good finisher is to level, smooth and clean off a top of yellow pine, so that when it is polished it is free from ripples or plane marks, and most craftsmen, therefore, prefer a test with a piece of hardwood, which is actually easier to finish off. Most timbers split, and they will split more if they are improperly seasoned, but as a matter of fact since the 1920 Exhibition innumerable numbers of most important works, including work in historical buildings, have been carried out, and throughout this time, over the whole of the work, we have had only one or two complaints—a record which cannot be equalled with the supplies of timber from any other sources. In the catalogue of the India and Burma exhibits at the British Empire Exhibition will be seen the list of important works which have been carried out. So great has been the prejudice, however, against new woods, and these in particular, that although our efforts have been attended with a measure of success, we have now, after ten years, found it impossible to continue longer, the cost being too great. You will be surprised to hear that after the introduction of mahogany it took well-nigh 50 years before the prejudice against it was overcome. On October 18th, 1845, it became necessary for 18 gentlemen, of whose descendants six are still in the trade in London, to sign a petition to the British Admiralty, stating that they had known the mahogany for up to 56 years, and urging the British Admiralty to use it. The memorial was addressed in the following terms :—

" We, the undersigned, having been long practically acquainted with the cutting up of Honduras mahogany do certify that the plank becomes more and more hard according to the time it is exposed to the air ; that it is very durable, is not subject to dry rot, and after seasoning does not shrink. We cordially recommend it for shipbuilding purposes."

The result was that, after a long delay, the British Admiralty decided that a trial should be given to mahogany for second-class ships. Is it not high time that everyone in this country who

needs to use timber should realise that the timbers of the Empire should come before all others ?

The lecturer then gave short particulars of the different timbers of India and Burma, according to the fuller list which was handed round.

At the conclusion, Mr. Howard was heartily thanked for his paper.—[*The Timber News.*]

THE FORESTRY MOVEMENT.

A New Generation of Planters.

Labour Difficulties (By Leslie S. Wood, President of the Royal English Arboricultural Society).

If anyone had wished to test the strength of the forestry movement, and to discover whether any real progress was being made in the country, he could not have done better than attend the series of provincial meetings held recently all through England under the direction of the Royal English Arboricultural Society. The fact that the Society had the confidence to announce and to carry into effect a series of two-day meetings, extending from Hampshire and Somerset in the south to Cumberland in the north, and ending with five days' hard work in Norfolk, is proof of the vitality of the forestry movement and of the rapidly increasing interest in the work.

In the course of these meetings, which were attended by landowners and their agents and foresters in considerable numbers, as well as by the officials of the Forestry Commission, a wide range of subjects came under discussion, and the series of debates on the problems of the day were very illuminating.

They showed that the chief hindrance to progress in the past had been the attitude of the owner and his agent, and that the great hope and motive power for the future was the rising generation with an entirely different outlook.

The older generation is convinced that forestry does not pay. It is useless to argue the point, as it has all the evidence that it

needs in the old plantations that it sees. They have been planted a hundred years or more; their original cost has accumulated at compound interest all these long years; and no one can pretend that the value to-day is anything like this accumulating sum. It is typical of these men that they will not fell their old timber. It is against their principle to allow their woodlands to lie waste, and as they are convinced that it will not pay to replant, they cannot allow themselves to remove the existing crop. Consequently there are thousands of acres of timber in this country unprofitable and depreciating in value.

Profitable Growth.—The rising generation takes a very different view. Instead of taking the old and unremunerative woods as proof of the unprofitableness of forestry, it thinks in terms of the young, fast-growing plantations which it sees springing up. Many of these plantations consist of modern conifers, the Douglas fir, Sitka spruce, Japanese larch, and Corsican pine. The trees are growing in size and increasing in value at a very rapid rate, and, although the rate of growth will decrease as the tree matures, there will be a profitable market for them long before the rate of growth drops below the normal rate of interest. The young landowner of to-day who is interested in his woods, does not think of long rotations nor does he use that old expression of "ripe" timber, which denotes the state immediately preceding decay when growth has stopped. He speaks of short rotations and of the profitable period of growth, and he is quite prepared to cut at 30 or 40 years and start again if he sees the opportunity of a good return. He sees no reason why old timber should be left to decay if he can fell it and invest part of the money in replanting with rapidly growing trees, and invest the balance in Government securities to bring in a better annual return than the old timber. He is not hampered with compound interest theories, and he does not find it necessary to call upon his trustees to find the capital for planting or to sell out his own securities; but if the proceeds of the sales of old timber are insufficient to finance the planting work, he is prepared to find the balance out of current funds. He is an optimist; he is not worried by bad planting

seasons, insect pests or diseases, not even by labour difficulties; his sole trouble is the rabbit. On some estates rabbits have been so far eliminated that it is possible to plant without wire netting, but generally speaking the rabbit has a strong hold in the country and is a source of serious loss to the forester.

It seems strange to speak of labour difficulties in the rural districts, but almost invariably owners of estates and public officials at all the centres visited spoke of the difficulty of getting men for their work. This seems to be due partly to the general shortage of men for rural work, owing to their absorption into other employment. The prosperity of the building trade in many parts of the country has drawn men from the land; and the higher wages offered to men for road improvements, for laying underground cables, and for special work in certain districts, such as in the neighbourhood of camps and coal mines, all tend to reduce the number available for forestry work. Much of this work is more highly paid, but it is uncertain, and men who belong to the district would prefer a permanent job at a reduced wage if the woodland wages could be made more attractive. In certain cases this has been done, but the artificial relation between the wages paid to men engaged in forestry operations and the agricultural labourer is restricting employment in forestry work. The Forestry Commission in some cases have come to a definite understanding that they will not pay rates of wages beyond those current for agricultural workers, and many landowners are unwilling to pay increased wages because they think it would prejudice the interests of their tenants. The result is that a growing industry is hampered in the encouragement that it is prepared to give to men to join in it, and at the same time it is constantly subject to attacks upon it by outside industries that offer better terms without any regard for the conveniences of farmers or any other employers of rural labour.

Town Labour Useless.—Many suggestions were forthcoming, but the general view, which is perhaps somewhat prejudiced, was that reliance upon purely town labour is useless. The powerful influence of the "dole" tends to create a dividing line between

town and country workers, and continual manual labour in open country exposed to all weathers is not popular with town workers, Forestry work is interesting and it appeals to the best type of rural worker; it has the advantage that it gives more employment in the winter than in the summer; but, if it is to reach its full development, it must be able to make an unrestricted appeal to the rural worker.

This shortage of labour is already having its effect upon the economic management of our woodlands and the progress of the forestry movement. This will become more noticeable every year. Hitherto planting operations have not been hindered by labour difficulties. Most of the planting work to-day is done by some form of notching; with a little care the men are easily instructed, and the work is done rapidly and does not call for a large amount of labour. Consequently landowners have been able to find the men for the work. Planting has in fact kept pace with the supply of plants in the country. The trouble arises in the young plantations, and all over England it is noticeable that these young areas are not being thinned sufficiently. The invariable reply is that it is not possible to get men for the work. The plantations of the modern quick-growing conifers come in for cleaning and thinning much sooner than the older plantations of European larch, Scotch firs, and mixed hard-woods, and unless they receive attention they suffer. The early treatment of plantation is not a profitable process, and consequently some owners are disposed to delay the work, in spite of the injurious effect, and are glad to make the shortage of labour their excuse. But the complaint is so universal that there is no question that it is genuine. If the trouble continues much longer, a large area of woodland must inevitably suffer, and the Forestry Commission and the private landowner who looks to the future will have to reduce their planting programmes. They will have to keep within such limits as will ensure that sufficient labour will be available to deal with the young plantations when they arrive at the age at which the cleaning and thinning operations begin, and have to be continued at regular intervals.

In some cases the postponement of the cleaning or thinning of plantations is due to lack of knowledge, but taking the country as a whole there is evidence of much wider knowledge of the management of woodlands to-day, compared with 20 years ago. We still find examples of plantations which are being ruined in their early stages by the estate carpenter or gardener, who is allowed an unrestricted right to cut out such trees as he requires, and who cuts out the best and fastest growing specimens and leaves the inferior and slower growing trees to form the final crop. It is also possible to find estates on which the timber merchant is allowed to mark for felling the trees that suit his purpose, without any regard for the future of the plantation. At the same time, it is satisfactory to know that these mistakes are being remedied and the general principles of management are understood much better to-day than at any time within living memory. The owner has better opportunity of acquiring knowledge from several sources ; all the rising generation of land agents find that a professional examination is essential for advancement, and forestry forms an important feature in that work ; and furthermore, every effort is made to train the working forester. There is an opportunity for a limited number to pass through the School of Forestry in the Forest of Dean, whilst a considerable number are members of the Royal English Arboricultural Society and attend their meetings and pass the examinations entitling them to certificates for proficiency in woodmancraft and scientific knowledge.

The forestry movement is recognized on all sides as a great national asset. It gives the nation greater security and adds to its wealth ; it gives a healthy occupation to rural workers ; and it has this advantage over all other industries that when once a scheme has been initiated and planting carried out, the natural growth of the trees compels the further employment of labour. This subsequently carries with it the development of subsidiary industries connected with the felling, hauling, and use of the crop, and adds to the general prosperity of the countryside.—[*The Times.*]

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"AFTER MANY DAYS."

Few workers in Nature's fields are so conscious as is the forester that he is indeed casting his bread upon the waters to find it after many days, or years, or lives. He departs from this mortal scene long before his successes, or, be it whispered, his failures, are evident, consoling himself, as he is entitled to, with the belief that in his case the Shakespearean dictum is reversed, and the good lives after him while his evil is interred with his bones. The worker on the chemistry side of the Utilisation Branch is not exempt from this scrap of proverbial philosophy. He may escape the 'lives' or even the 'years' penalty, but it is certainly true that it is only 'after many days' that he finds out with certainty what he is after, or, is found out. And of this we have just had an ensample.

To clarify what follows let us say that the value of any forest product as a raw material for producing paper pulp depends very largely, first, upon what it costs for the chemicals required to reduce it to pulp and, second, upon what amount of bleaching agent is necessary to bleach the pulp to a pure white colour. The digestion systems possible for the reduction of bamboo to pulp are three, known as the Sulphite, Sulphate and Soda methods; all three are in use for wood-pulp. The Sulphite we discarded at an early stage of our enquiry for reasons which are of no interest to this present history. The other two both depend upon the use of Soda (Na_2O) but differ in their application of it and to distinguish them they are spoken of as the 'straight Soda' and 'Sulphate' systems. In both, the spent soda is recovered for

re-use as Soda carbonate which is converted into Caustic Soda by treatment with lime, and, in the straight soda method, the losses during the digestion and recovery cycle are replaced by fresh soda carbonate and the final digesting liquor is wholly caustic soda. In the Sulphate method the losses are replaced by sulphate of soda, a cheaper salt than carbonate, which in the smelting furnace which is the finale of the recovery process, becomes Sodium Sulphide (Na_2S) and the digesting liquor is a mixture of the latter and Caustic Soda. With raw materials to which it is applicable (bamboo being one of them) the sulphate is not only cheaper in replacement cost than straight soda, but the presence of sulphide retards the hydrolysation and loss of pulp during digestion, so the yield is usually 2 to 3 per cent. more, and there are other economies in capital and in recurring costs of the recovery process.

When we began our investigation in 1910 the previous best figures facing us, got by the straight soda method, were round about 25 per cent. of caustic soda on bamboo, and 22 per cent. of bleaching powder, calculated on the unbleached pulp; and even with that colour was not satisfactory. At present costs in India these represent about Rs. 91 per ton of pulp for chemicals alone, a figure which, if maintained, would put bamboo out of this market for ever. We had no difficulty in concluding that the sulphate method offered the best hopes of improving on this, and our first report, published in 1912, detailed our results by this system, bringing the figures down to 20 and 16 per cent. respectively with a cost of Rs. 64. Colour was satisfactory and the yield improved by 2 per cent. We were unable to continue with the sulphate system because the bronze digesters then available were unsuitable, owing to a reaction between the sulphide in the liquor and the copper in the bronze producing copper sulphide, which not only spoilt the appearance of the pulp but endangered the digesters, so we had to revert to the straight soda method until we were in possession of steel digesters such as we now have. We had got to the stage where it was evident that further improvement lay in the application of the digestion reagents rather than in the reagents themselves, a line of enquiry which has

resulted in what is now known as fractional digestion and for this purpose straight soda was just as useful to us as sulphate, knowing, as we did, that we could always, by simple formulæ translate the figures of one system into those of the other.

But, and here comes in the application of the scrap of philosophy with which this essay began, during the investigation, 1910 to 1912, we obtained clear indications that it was possible to reach figures of about 18 for soda and 10 for bleach. It was impossible to publish them : compared with 25 and 22, they were too revolutionary and would have brought a storm of criticism about our ears to which we had then no effective reply, but we "treasured them in our heart" and have been following the gleam ever since. We have for some time been in a position to revert to sulphate, and the figures are now 18 and 8 representing a chemical cost for bleached pulp of Rs. 42 per ton and Rs. 38 if chemicals are credited with the gain in pulp yield. It is the combination of fractional digestion with sulphate which does it. Neither would do it alone.

"After Many Days."

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SOME TYPES OF TEAK DEFOLIATION.

As a result of the investigations into the defoliation of teak which have been carried on in Southern India by the Forest Entomologist since 1924 certain types of defoliation have been recognized as characteristic of particular species of insects, so much so that in many cases it is possible for the initiated to determine the species of insect responsible from specimens of the damaged leaves only.

Though in Nilambur some 26 species have been recognized as regular teak feeders, the well-known *Hybloea puera* Cram. and *Pyrausta machaeralis* Wlk. are outstanding, and are the primary causes of the complete stripping of foliage that occurs periodically

over wide-spread areas. These two species are frequently referred to by their popular names of "Teak Leaf Defoliator" and "Teak Leaf Skeletonizer." These names are appropriate enough, if it is recognized that *Hybloea puera* is not the only species that completely strips the leaves of their green tissue, and that skeletonization of the leaves is not confined to *Pyrausta machaeralis*.

The type of defoliation caused by any species depends upon (1) the age (*i.e.*, capabilities) of the larvæ and (2) the age (*i.e.*, texture) of the leaves, and an insect that, when mature, eats the whole leaf down to, and sometimes including, the main veins, will obviously not be able to do so immediately on hatching from the egg; nor will a larva that is capable of biting out large holes, veins and all, in a tender young leaf, necessarily display similar capabilities when feeding on a tough mature leaf.

Thus in the case of *Hybloea puera*, young larvæ hatching on tender leaves (those for instance of the new flush resulting from previous defoliation) typically cut very regular circular holes in the leaf, or semi-circular if at the edge, turning over the flaps to form shallow cells in which they take refuge, and sallying forth to consume the green tissue (Plate 2, fig. 2). If, on the other hand, the larvæ hatch on old leaves, they are unable at first to deal with the leaf in this manner and are forced to skeletonize it, as shown in Plate 2, fig. 1. This skeletonization by young *H. puera* larvæ is easily distinguishable from that of *P. machaeralis* described below, and is much more ragged and untidy in appearance, the smaller veinlets being eaten in patches, but with unconsumed tissue left here and there. The edge of the leaf between the main veins disappears, and, in fact, the main veins with their attached mesh of veinlets and patches of tissue are frequently separated almost to the midrib.

In either case the larvæ, as they mature, become capable of grappling with tougher propositions, and eventually reduce the leaves to the condition shown in Plate 2, fig. 4, with only midrib, main veins, and occasionally patches of green tissue left. These patches frequently bear the old folds constructed as shelters by the larvæ—probably the reason they are left unconsumed. The

construction of these folds is characteristic of *H. puera* throughout the larval period.

The reduction of the leaf to the condition of complete stripping illustrated in Plate 2, fig. 4 is not, however, confined to *H. puera*. More than one species of Arctiidæ have been bred from teak and their mature larvæ are characterised by similar work. Species of Sphingidæ, also, have been taken on teak, with similar feeding habits, a slight difference being that the sphingid larvæ are larger and consequently more able to deal with the side veins. Complete contempt for the side veins and even occasionally for portions of the midrib also is, however, best seen in the case of *Aularches miliaris*, Linn., a large warningly-coloured grasshopper of the family Acridiidæ, which is commonly found attacking the younger plantations (Plate 3, fig. 4).

To turn now to *Pyrausta machaeralis*. This species is typically a skeletonizer, producing very characteristic work. (Plate 3, fig. 1). All the green tissue is eaten away, leaving a very regular fine mesh of veins and veinlets extending to the margin of the leaf, which remains more or less entire—in cases of mature larvæ some of the veinlets also are occasionally consumed, as indicated towards the centre of the figure. To permit of more definite determination of the author of the work the small webbed cells constructed by the larvæ over depressions along the main veins, etc., often remain visible on the leaf skeleton.

Another type of skeletonization which might conceivably be confused with that of *P. machaeralis* is the work of the young larvæ of *Diacrisia obliqua*, Wlk., one of the Arctiidæ referred to above as causing, when mature, defoliation similar to that of mature *H. puera* larvæ. This work is figured on Plate 2, fig. 3. It is much more delicate than that of *P. machaeralis*, the whole leaf being completely covered by the most minute punctures, leaving every veinlet intact. In fact a casual glance hardly serves to show that the leaf is damaged at all; it is only closer inspection which reveals that it is quite transparent. This effect is heightened by the fact that the larvæ appear to feed only on the upper surface, and their punctures frequently fail to remove a

great part of the lower epidermis of the leaf, which in consequence still appears green. The margin of the leaf is not damaged at all.

Just as in the case of *H. puera*, the larvæ of *P. machaeralis* are capable of dealing with the tissues of a young leaf in a more wholesale fashion. The small veinlets in this case present no difficulty, and the larvæ are enabled to eat out large holes in the leaf. (Plate 3, fig. 2.) As *Pyrausta* appears, however, to prefer the mature leaves, skeletonization is the typical method of feeding, and more commonly found than the other. Such circular or oval holes, on either old or young leaf, are characteristic of several species of Geometridæ also (species of *Hyposidea*, *Biston*, *Boarmia*).

A torn, ragged appearance of the edge of the leaf is typical of the feeding of several species of Curculionidæ (Plate 3, figs. 3 and 5), and small holes (smaller than a pea) are indicative of various species of Chrysomelidæ, which have been taken feeding on teak. The damage done, however, by these families does not appear to be serious.

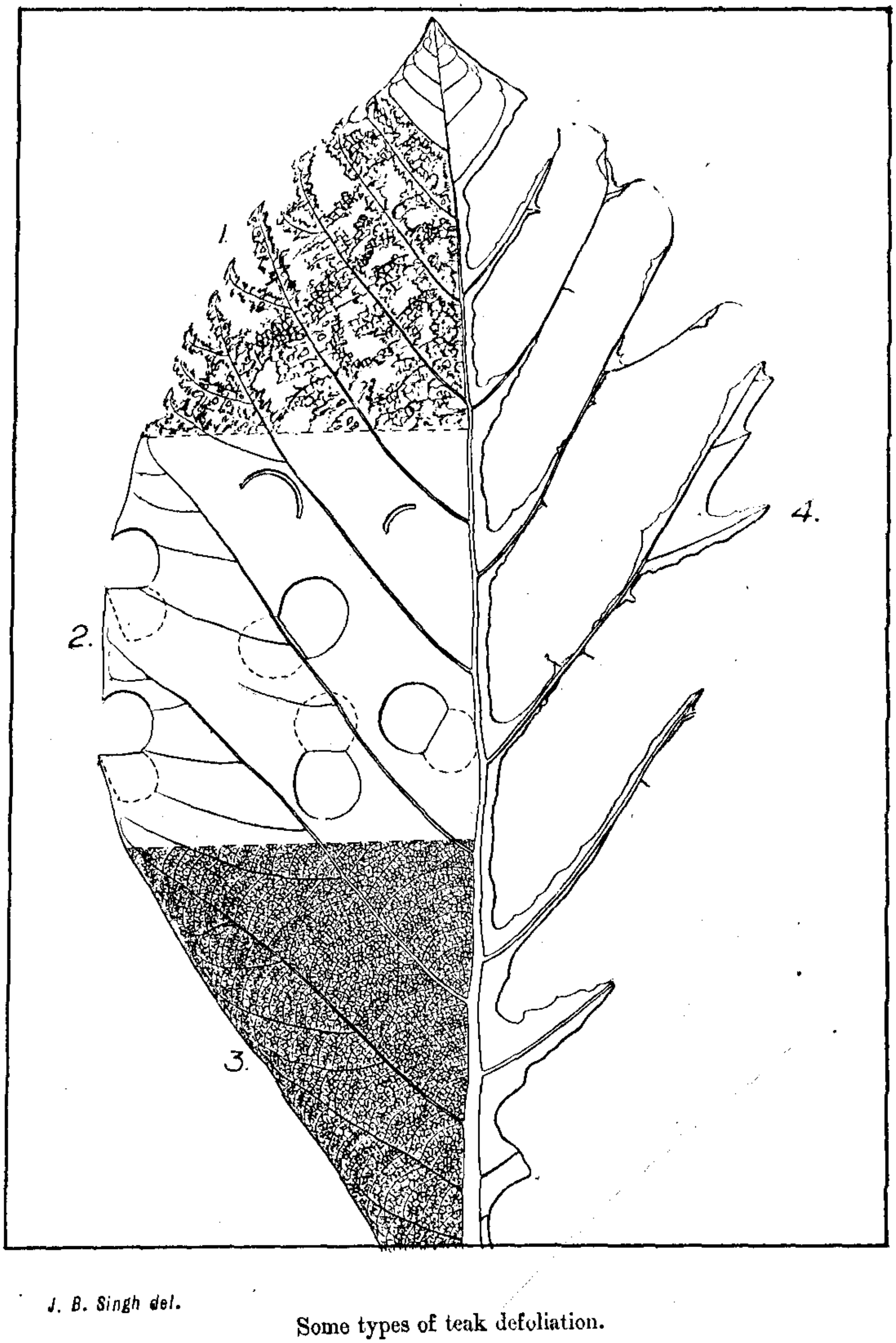
In conclusion, it should be remembered that the types of damage described in this note are only those found to occur in Nilambur, and defoliation occurring in the C. P. or Burma, for, instance, found to correspond more or less with one of these types, should not necessarily at once be assigned, without further investigation, to the species here mentioned. The types of defoliation herein described do not pretend to be exhaustive, and it is more than probable that, with the varying fauna supported by teak throughout its distribution, not only will additional species be found whose work approximates to one of these types, but also additional types of defoliation will appear.

D. J. ATKINSON,
Forest Entomologist.

EXPLANATION OF PLATE 2.

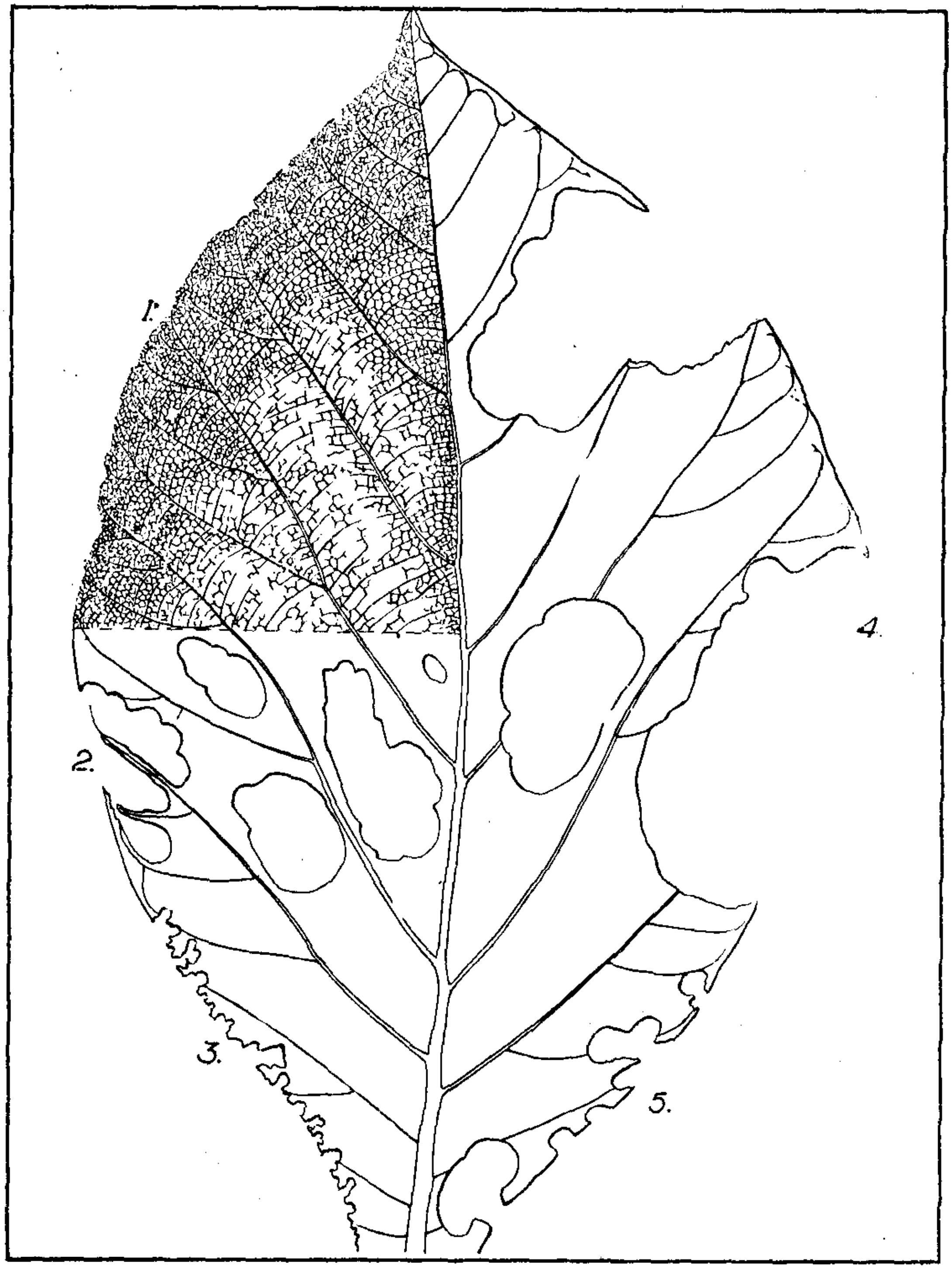
Fig 1. Skeletonization of old teak leaf by young larvæ of *Hybloea puera* Cram. (family Noctuidæ).

,, 2. Folds on young teak leaf caused by young larvæ of *Hybloea puera*, Cram. (family Noctuidæ).



J. B. Singh del.

Some types of teak defoliation.



J. B. Singh del.

Some types of teak defoliation.

Fig. 3. Skeletonization of teak leaf by young larvæ of *Diacrisia obliqua*, Wlk. (family Arctiidæ).

„ 4. Damage (complete stripping) to teak leaf by mature larvæ of *Hybloea puera*, Cram. (family Noctuidæ) or *Diacrisia obliqua*, Wlk. (family Arctiidæ).

EXPLANATION OF PLATE 3.

Fig. 1. Skeletonization of mature teak leaf by larvæ of *Pyrausta machæralis*, Wlk. (family Pyralidæ).

„ 2. Damage to young teak leaf by larvæ of *Pyrausta machæralis*, Wlk. (family Pyralidæ), *or*
Damage to teak leaf by larvæ of various species of Geometridæ.

„ 3. Damage to edge of teak leaf by adults of *Astycus aurovittatus*, Hell. (family Curculionidæ).

„ 4. Damage to teak leaf by nymphs and adults of *Aularches miliaris* Linn. (Family Acridiidæ).

„ 5. Damage to edge of teak leaf by adults of *Sympiezomias beesoni* (family Curculionidæ).

REVIEWS.

FORESTRY IN THE UNITED PROVINCES.

Perusal of the Report for 1924-25 reveals several points of general interest. The chief of these lies in the numerous references to the changed policy in the Kumaon hill forests and its consequences. Full forest settlement procedure was applied to this region in 1911-17 resulting in the reservation of over 3,000 sq. miles of forests adequately demarcated and with rights and concessions all fixed and recorded. Agitation resulted in the appointment of a "Grievances Committee" in 1921 on whose report action is being taken. The general principle of the findings of this Committee seems to have been to let the villagers have virtually everything they asked for in the way of unlimited grazing, and forest produce, disforestation of isolated blocks and so on, whilst for the present at least, a fair amount of control is being retained for the bigger and more remote areas of forest where villages are few and so pressure slight. The oak areas, much of which have suffered from lopping almost to the point of annihilation, appear to have been abandoned to their fate; powers of recuperative closure are retained, but it looks as though the local forest officers will have to pull all their weight to get anything done, since many of these places are in urgent need of the protection which was beginning to be extended to them. In all, 139 sq. miles have been disforested and some 33 more are to follow. Moreover, 1,188 sq. miles of the remainder have been classed as Class I in which there is to be virtually no control. The loss of another square mile for potato cultivation will be noticed as possibly of sinister import. There seems to be an intention to play with the idea of constituting communal forests, but what grounds exist for optimism as regards their success is not apparent from the report, in fact straws in the wind indicate the reverse; thus, though resin-tapping brings in nearly three lakhs annually as wages, there is still agitation against it, and the Almora fuel sales (from regulated fellings) were *nil*

instead of about 20,000 maunds, the demand having presumably been met by destruction of the nearest remnants of forest.

We note that the Chief Conservator of Forests does not express his opinion as to whether the "gratuitous co-operation of the people" which is "an absolute necessity" in the suggested introduction of controlled burning of resin coupes (para. 21), will be forthcoming. It seems impossible to escape the view that just those very areas have been given up to destruction which were, in the interests of the population, most in need of protection.

The continued destruction of the oak areas is not likely to affect revenue figures, and therefore will tend to attract little notice except to observers on the spot, but it is the oak rather than the pine which protects the soil, checks run-off and enhances the productive capacity of the locality. This case of Kumaon seems to be one of the examples where a population ought to be protected against itself, however unpopular such action may be: the benefits consequent on the reservations of the earlier forest settlement round Ranikhet are absolutely undisputable and obvious for anyone to see, and had there been a grievances committee in those days which was ready to be influenced by importuning interested parties, much of the forest then reserved would now be almost bare rock with but a little grass covering it in the rains. There was an able Forest Officer in the committee, and it appears certain that the conclusions to be reached had been decided on beforehand on political grounds, and that all that could be done was to save what little was permitted to be saved, in other words, to make the best of a very bad job.

Turning to general matters and the other circles, the outstanding feature is the excellent position as regards working plans. Apparently there are but 6 sq. miles for which no working plan exists, and revisions due are well in hand. Even for Kumaon, a plan for one division has been sent to the press, and that for a second submitted for sanction (some eight years after it was commenced).

The chapter on silviculture is disappointing and depressing, especially as coming from a Province which prides itself as being in the van of progress in this respect. As regards regeneration of

sal, a note of extreme caution is sounded except where coppicing is possible. It is certainly surprising that after so many years, the problem of the natural regeneration of *sal* seems to be as far off as ever from solution. For natural regeneration of other species we read that all experimental work so far carried out has given entirely negative results, and but little progress can be recorded for *Quercus incana* in the hills, though *Quercus dilatata* offers no great difficulties under the shelterwood system. In Chakrata some plots dealing with the regeneration of high level conifers were abandoned, and concentrated regeneration in deodar forest is found unsatisfactory: there seems to be here a likely field for the provincial silviculturist, as there are grounds for believing that failure in the plots was largely due to the planting and sowing work getting delayed after the fellings were made. An extension of *taungya* for regeneration of *sal* to a new division, Gonda, is recorded, and it is to be hoped that it will be made a success and serve to goad Bahraich into taking some measures to make cultivators available—almost any terms are worth while to make a start, and the start is the really difficult thing.

The afforestation of the ravine lands of the Chambal and Jumna rivers continues, a further 2,228 acres having been planted up, bringing the total up to 12,247 acres. The figures appear to be 1,842 and 11,019 acres in Form 18 A. More attention has been given to bamboos, which is not surprising, and the high percentage of success among the plants put out is very satisfactory.

The inadequacy of the funds available for buildings is again urged, and it is to be hoped that the United Provinces Government will see reason in the matter. It would appear that a rather vital negative has been omitted by a printer's error in the second part of para. 49 regarding success of selling on royalty only.

The actual revenue, expenditure, and surplus for the year are shown in lakhs of rupees as 69, 36¼, and 32¾ respectively, but the real profits of the year's working are estimated at 37 lakhs or 3 lakhs more than the previous year.

Two short paragraphs at the end of the report may also be mentioned. One announces the approaching appearance of a new edition of the U. P. Forest Manual, and the other refers appreciatively to the value of forest dispensaries which have been established in the Western and Eastern Circles.

FORESTRY IN ASSAM, 1924-25.

The two most urgent needs in Assam forestry seem to be the making of Working Plans and the improvement of lines of communication. As to the first, it is regrettable that owing to illness and other reasons referred to later no great advance has been made. Comparatively little has been done during the year towards that improvement of communications which is essential for successful exploitation ; there seems to be a shortage of funds for this purpose. The department was unlucky in having to repair considerable damage caused by a cloud burst to the newly finished tramline; this line, which up to the present has cost Rs. 2,80,445, has proved to be a financial success.

The department has been subject to a certain amount of criticism by the Legislative Council, criticism which, to say the least, is neither constructive nor calculated to increase public confidence, especially as the publication containing the adverse criticism (Assam Gazette) is likely to have a much wider circulation than the Progress Report of the Forest Department which contains refutations of certain statements and indeed shows them to be unbased on fact. It is notoriously difficult to educate the lay public up to the point of realising anything in favour of systematic forest management: the *raiyat* will probably never see the Department in any other light than that of an irritatingly restricting officialdom. It is all the more important then, that one holding such a high position as a Member of Legislative Council should make sure of his facts before placing his censure on record.

It is interesting to note that the outturn of timber from Reserved Forests was nearly three times that of 1921-1922.

Taungya areas in Cachar Division "could not be planted owing to the seed procured from Burma being bad." In Sylhet, however, Chittagong seed was used and proved satisfactory. The

question of bad seed seems to be one worthy of investigation especially as failure to plant areas has been reported before for the same reason (Sadya, 1921-1922). On a subsequent page in the Report, under the heading "Research and Experiments" we find a comparison between teak seed from "forest trees in Burma and from "roadside trees in Sylhet" and we are not surprised that seedlings derived from the former were much superior. Observations of percentage germination of the Burmese teak would have been interesting. The conclusion, however, may be drawn that Burma seed "when it is good, is very good."

The factors governing the regeneration of sal are little understood and it is interesting in this connection to note the advantageous effects of grazing in Haltugaon; the writer of the report suggests that a judicious combination of fire and grazing may be a solution of the problem.

With regard to damage by animals, honours for priority seem to be divided between the Mammalia *(Homo immoralis semisapiens)* and the Insecta *(Dihammus cervinus)*. The latter is undoubtedly a dangerous pest and its control is under consideration at the Forest Research Institute.

The Report is the last to be compiled by the retiring Conservator, Mr. Trafford, who has for some time held charge of the two circles in the province, and did so throughout the year under report.

No great progress can be looked for in forest matters in Assam until the Legislative Council and the Government realise that they will not develop their forest estate by keeping a Conservator's and a number of deputy and assistant conservator's posts vacant. There may be a saving in salaries, but all other provinces have long ago realised that trained forest officers are an asset and not an encumbrance.

SPECIES.

Under the above heading Mr. Turrill has written an essay in the Journal of Botany dealing with the species question from the point of view of a Systematic Botanist. The essay is in places

too technical for the general reader, who has not followed recent literature on genetics and similar subjects, but the following has been extracted from or suggested by his essay.

It is probably well known that no absolute definition of the term "species" has ever been found that will work in practice. At the same time most people have a fairly good idea of what a "species" is, and it is the basis of all systems of classification. Many people hold the view that a species is merely a convenient and more or less arbitrary grouping of individuals. In common usage species in different genera certainly do not have the same value, and consequently statistical studies based on the number of species in different genera or regions labour under the disadvantage of comparing units the values of which are not constant and strictly comparable.

If the species is looked upon as being merely a convenient unit for purposes of classification there is no particular reason why its value should be constant, but some, if not most, species do seem to represent some natural unit, and consequently it is desirable to have if possible a means of recognizing these units.

As a general rule species are based on morphological characters. All the members of a species will resemble one another by the possession of certain morphological characters or groups of characters. This is not a basis for the definition of a species since larger groups such as genera might be defined in the same way. Further some morphological characters are physiological and are constant only under similar environmental conditions. Little is known about these as yet nor can they be very readily studied.

Anatomical characters often give useful indications, but in themselves they are no more reliable for taxonomic work than morphological characters, and they are not so easily observed. Chemical tests have also been applied and have been relied upon by a few workers on this aspect of the species problem. The general taxonomist perhaps rightly places little value on the results. The exact significance of the presence of products such as essential oils or alkaloids in the plant is not clear, and the

amounts, if not the actual composition, of the substances present is undoubtedly affected by physiological conditions.

The results of modern work in genetics has not been of much use to the taxonomists. Geneticists study inheritance of characters which only occasionally include some which the taxonomist would consider to be of specific value. There is, however, no general difference in the inheritance of characters which the taxonomist would regard as of classificatory value and of other characters to which he would attach no importance.

Two varieties of the same species differ from one another in fewer characters than two species of the same genus or two genera of the same family. Although this is true in general it is not possible to define the number of differences and to say, for example, that *varieties differ in one character and species in 20* characters, since plants will be found differing from one another in 1, 2, 3 .....18, 19, 20 characters and some of these characters may be "important" and others of little value. If it were decided that species must differ by 20 characters and varieties by only one character, how are plants differing by 5, 10 or 15, characters to be classified? Many characters are necessarily alternative such as tallness or dwarfness, hairiness and smoothness and cannot both be present. *In such cases in crossing one or other character dominates* or they may cancel out. In the latter event in the offspring of known parentage there would be a reduction of characters. Characters may not be definitely linked in pairs as above but may appear as the result of the interaction of several tendencies thus leading in breeding experiments to the appearance of additional unexpected differences. It is therefore evident that species cannot be defined by definite numbers of different characters.

Failure to cross or sterility of offspring on crossing has been suggested as the main or sole criterion for specific limits. This test also gives no absolute value as many crosses between very distinct individuals have been made and the hybrids have proved fertile. On the other hand some closely related species cannot be crossed and some races or varieties cannot be crossed with other races or varieties of what the taxonomist would consider the same species. It thus comes about that a

group of individuals possibly originating from a casual hybrid or a segregate of a species may become "isolated" by failure to cross with neighbouring individuals with slightly different characters. If such a group maintained itself it would form a population which the taxonomist would probably regard as a species. "Isolation" appears to be an important factor in the establishing of a species. This is not necessarily geographical isolation, as a plant may be isolated from its neighbours by having a different flowering period, a different habitat or crossing incompatibilities. It seems probable that many species have become established in some such way in nature since they maintain themselves indefinitely with little or no hybridization, whereas if taken from their natural surroundings and cultivated they may cross with the greatest facility.

In conclusion Mr. Turrill states:—

"No single absolute test for a species is yet known, and it is debatable if such is ever likely to be found, but as a working hypothesis the following criteria should be considered: a species is morphologically definable in that it has a sum-total of characters, and every individual within it has constant resemblances with every other individual within it, and constant differences from every individual of other species, even when the individuals are grown under diverse conditions; species are isolated from one another, sometimes geographically, sometimes by habitat preferences, sometimes by having different flowering periods, usually by not crossing naturally to produce a completely fertile offspring. A species is an isolated group of individuals whose sum of characters tends to keep constant by natural in-breeding."

An alternative definition of species is given by Jordan and Kellogg, "Evolution and Animal Life":—"Each kind of animal or plant, that is, each set of forms which in the changes of the ages has diverged tangibly from its neighbours, is called a species. There is no absolute definition for the word species. The word 'kind' represents it exactly in common language, and is just as susceptible to exact definition. The scientific idea of species does not differ materially from the popular notion. A kind of tree or bird or squirrel is a species. Those individuals which agree

very closely in structure and function belong to the same species, There is no absolute test, other than the common judgment of men competent to decide."

PROGRESS IN AGRICULTURE IN INDIA.

At the State opening of the winter session of the Legislative Assembly at Delhi on January 20th, H. E. the Viceroy said in the course of his address, referring to the decision to appoint a Royal Commission to enquire into agricultural conditions in India :—

"In my view, this decision embodies a measure of cardinal importance in the interest of the premier industry of India, and of its people, the great majority of whom live directly by agricultural operations, or by occupations connected with the disposal of agricultural produce. The purpose it has in view, I feel sure, will commend itself to every class and creed and to all shades of opinion in this country. Its mission is wholly beneficent. It can bring nothing but advantage to the country, as a whole, and to those classes of the people whose interests must always be of supreme importance to both the Central and Provincial Governments. If it results, as I trust it may, in bringing to many thousands of homes a somewhat greater share in the wealth of this world, a higher degree of comfort and self-respect, and a better basis for self-improvement and progress, then I and my Government will be amply rewarded for our part in bringing it into existence."

These are brave words and every forest officer will feel that they are genuine. The forest officer has in a special degree opportunities of seeing the inner lives of many humble agriculturists who live in the out-of-the-way corners of India, perhaps surrounded by dense forests. It is probably not too much to say that no other Government servant has such good chances of understanding the difficulties of these remote lives, lived in millions, far from railways and roads and district officers.

It is of interest to note what the Agricultural Research Institute at Pusa has been doing meanwhile and to estimate how their years of laborious investigations have paved the way for the

Royal Commission. The central nature of their work is emphasised by Dr. Clouston in the Scientific Reports of the Agricultural Research Institute, Pusa, for 1924-25 thus : "The main aim of the research work carried on at the Institute is to establish principles which can be applied to local problems by Provincial Departments."

In botanical investigation progress appears to have been made with good strains of wheat, a new type called Pusa 52 having been fixed. "It compares well both as regards yield and rust resistance with the older selections and being a bearded variety it is not liable to damage by birds and animals. During the past season it gave 9,476 lb. of grain over an area of 4·22 acres or roughly 37½ bushels per acre."

Tobacco has also received attention, as the experts at Pusa have been trying to evolve an Indian tobacco resembling good American leaf in flavour, colour and smoking qualities, which will still have Indian hardiness.

"Hybridization is being employed for reproducing a large-seeded race of linseed with a root system adapted to the Gangetic alluvium. Work on pigeon-pea is proceeding on two lines, namely, the separation of unit species from the mixed field crop and the isolation of a type which will prove resistant to wilt disease. An experiment has been started during the year on the raising of sugarcane seedlings in Bihar. The results will be awaited with considerable interest, for, if the experiment is successful, it may be possible to discern, both earlier and more accurately, those types which are capable of withstanding the diseases and climate of Bihar. Oats, barley, maize, gram, sesamum, safflower, *urid* (*Phaseolus radiatus*) and *mung* (*P. mungo*) are other food crops which are being systematically investigated for isolation of types superior, both in yield and agricultural characters, to the mixtures at present grown."

Among subjects investigated by the Chemical Section was a method of preparing dicalcic phosphate from apatite (phosphate of lime) which is found in abundance in some parts of Bihar.

The movement of nitrates in the soil and sub-soil have been further studied. " The observations made during the year indicate that the distribution of nitrates in the soil, besides being regulated by rainfall and the nature of sub-soil layers, is profoundly modified by the growth of crops and the cultural operations which the field receives."

In the Bacteriological Section much progress was made in the investigation into nitrogen fixation in soil by non-symbiotic organisms. " By means of composting with sulphur the natural indigenous source of phosphate in the form of bones can be effectively utilized in place of imported super-phosphate."

The Mycologists have made progress in the pigeon-pea wilt problem. " Estimations of moisture carried out in all the latter plots four times, to a depth of two feet, dispose of the theory often advanced that the highly wilted plants are water-logged. An investigation has been started on a new disease reported from Lower Burma as being the cause of the death of young cinchona plants. The preliminary observations made indicate that neither fungi nor bacteria are responsible for the symptoms which are probably physiological." Blights on sugarcane and potatoes have also been investigated.

The Entomologists visited the Andamans to investigate a serious caterpillar pest on coconut palms.

" On the Pusa farm, *Brachytypes portentosus* was successfully controlled in a field of Roselle, by pouring petrol in their burrows, while *Pyrilla* spp. in sugarcane plots were effectively dealt with by spraying the canes with crude oil emulsion."

" Observations on the lac insect were continued with special reference to obtaining a parthenogenetic brood."

Much progress was made in the Agricultural Section and the Director writes " Three outstanding facts of practical importance have emerged from the data available from the cattle-breeding policy hitherto pursued, *viz.*, the prepotency of the sire in milk production, the shortening of the dry period by weaning the calves from birth, and the value of green food for dairy cows throughout the year."

The dairy experts have also done good work, for example:— "On the farms at Karnal, Bangalore and Wellington, three of the best indigenous milch breeds are being improved by better feeding and selective breeding. Two of these indigenous breeds are being crossed with two of the most famous milch breeds of the West, *viz.*, the Ayrshire and Holstein." Nothing could be better for India.

The Physiological Chemist has done excellent work in investigations into feeding stuffs for cattle, and the sugarcane breeding experiments have yielded most valuable data.

The above brief extracts give some idea of the useful activities of Pusa and it will surely be accepted that the task of the Royal Commission is to find means of making known to the cultivator all over this vast country how he can improve his crops and his cattle. Can he be induced to believe that it is no longer right that he should count his wealth, like the heroes of the Bible, in number of head of cattle? Can Pusa prove to him that he will benefit in every way by having a few good cattle rather than a large herd of miserable half-starved animals? This is probably one of the directions in which India's greatest need lies. And certainly the forest officer will be only too glad to help in this revolution because in only too many parts of India are his forests ruined year after year by over-grazing and cruel lopping.

THE USEFUL TREES OF NORTHERN NIGERIA.

By H. V. Lely, Assistant Conservator of Forests, Nigeria. (Crown Agents for the Colonies, 4, Millbank, London, S. W. 1, 1925. Price 10/-).

This useful volume gives a description with line drawings of 120 of the most important trees of the savannah forests of Northern Nigeria. Details are given on the wood and uses of the wood and other parts of the tree in each case, as well as the habit and botanical characteristics. An excellent feature is that in each case the letter-press faces the plate it refers to.

No less than one-third of the total number of species belongs to the *Leguminosæ*, among which a number of genera which are

well represented in India occur, such as *Erythrina*, *Pterocarpus*, *Cassia*, *Bauhinia*, *Afzelia*, *Tamarindus*, *Parkia*, *Entada*, *Albizzia*, *Acacia*, and *Parkinsonia*. *Parkinsonia aculeata*, The Jerusalem Thorn, is not a native of India or Burma, but was introduced as a hedge plant in dry areas from America, and it has also been introduced into Nigeria, by Arabs, and into other tropical countries. Other genera found in Northern Nigeria, which have representatives in India are, *Bombax*, *Odina*, *Balanites*, *Adina*, *Zizyphus*, *Vitex*, *Ochna*, *Boswellia*, *Grewia*, *Randia*, *Diospyros*, *Bridelia*, *Eugenia*, *Ficus*, *Strychnos*, etc. Two *Dipterocarps* are described, *Lophira alata* and *Monotes Kerstingii*, but they seem to be of little importance. *Monotes* grows pure in patches over large areas. *Anogeissus leiocarpus* is described as probably the most evenly and widely distributed of all trees in the savannah forests. Like *Anogeissus acuminata* the foliage is graceful and feathery. The wood is burnt and the ash used for fixing dyes.

As would be expected in savannah forests, *Combretums* are numerous.

A small araliaceous tree, 20 feet in height, *Cussonia nigerica*, is noticeable from its quaint shape and stout flower-spikes.

The drawings are clear and carefully executed and should be very useful in the field. They have been with few exceptions clearly reproduced though the paper is rather thin.

It may perhaps be regretted that the book could not have been reproduced in a smaller size, so that it could be carried in the pocket, but the author notes that wherever possible the drawings are the actual size of the specimens of leaves, flowers and fruits, and that would not have been possible in a pocket edition.

An interesting Table of Flowering Seasons and a list of native names are given. As in India, a large number of species flower in February, March and April. Very wisely the author warns those who study the trees in the forest against accepting native names without confirmation.

A clearly written preface gives the reader a good idea of the savannah forests of Northern Nigeria. The author makes some interesting remarks on the aggressive nature of savannah forest growth, pointing out that it is always ready to seize every

opportunity of occupying more land, favouring very often inferior species, and ousting superior trees and shrubs.

He calls "tree savannah" a tall type having a light closed canopy with a few shrubs and a little grass: while "bush savannah" is more open and not so high, more spreading with more low branches, and many stunted shrubs and a dense growth of grass. He mentions several sub-types, and readers in India will recognize what they signify from a short list of the principal trees found in each :—

1. PARK SAVANNAH.—*Parkia, Afzelia, Tamarind, Acacia Terminalia* and *Paradaniellia Oliveri*. The last named is a very large valuable fast-growing timber tree belonging to the *Leguminosæ*.

2. FRINGING FORESTS, along stream banks.—*Eugenia, Adina, Diospyros* and Jasmines.

3. KURIMI, or forests in depressions, an enlarged variety of 2.—*Albizzia, Diospyros*, Oil-palms. The principal source of timber in the Northern Provinces.

4. FADAMMA, or broad depressions often inundated.—*Mitragyne, Paradaniellia, Borassus.*

Pure forests are rare but gregarious clumps of *Acacia, Anogeissus, Bauhinia, Bombax, Terminalia, Gardenia, Boswellia* etc., are often met with.

"Over wide areas of savannah there are to be found many evidences of previous people in the shape of walled ruins, foundations of corn stores, grindstones, and heaps of hand-picked stones indicative of cultivation. The dating of such remains gives the approximate age of the forest growth, and from this evidence it would appear that certain types of savannah deteriorate considerably with age and that farming will regenerate them to a certain extent."

" In conclusion a short account of the growth and characteristics of savannah forests is given. As would be expected, the trees, being subject throughout life to extremely hard conditions, counter with defensive measures for self-preservation. Most of them are prolific seeders and many have the habit of retaining

their fruits or seeds on the tree for many months, sometimes right round to the next flowering season. Germination of seeds is a matter of chance when the tree is liable to ground fires from October to April or May. The life of a seedling, too, is precarious, since at the age of six months it may be subject to a devastating fire. In later life, a fire occurring in April, may, if the grass is high, burn the bark to ashes on the outside, destroying all fruits or seeds, killing the twigs and small branches and apparently destroying all life. Yet, a month later leaves will spring from all but the burnt tips, the tree losing a year's height growth, but in a position to put on another year's stem girth. Wounds on the trunk of a tree heal over with the formation of a hollow or rotten core. Trees 4—5 feet in girth have been felled and their stems found to consist of a mere shell two or three inches thick. The hollow is filled either with the workings of termites or the fermenting sap which is forced up from the ground level and will pour out of the stump. Savannah trees are adapted to overcome most of these adverse conditions. Heavy crops of fruit and seed, rapid ripening of seeds of fire-resisting fruit coats and various means of distribution are means to ensure germination. Deep or thickened tap roots of seedlings are put down in the first year so that though the seedling may be levelled by fire it will appear with renewed vigour soon after. A very short flowering period for the individual tree is a marked characteristic of many species. Fire has a quickening effect on the flowering and leaf bearing of trees to a marked degree. A grass fire in November may produce flowers and leaves in December on trees which, if unburnt, would not have flowered till February. As a rule no tree will flower again if the first flowers have been burnt off, though it will, of course, bear leaves. One or two exceptions, very rare, have been noticed by the author, but these were due to the peculiarity that some trees exhibit of bearing flowers on some of their branches and not on others, so that the flowerless twigs were probably excited by the fire into bearing flowers after it. Leaves are readily replaced after attacks by locusts which generally take place early in the season. The end of the cold weather and first sign of heat is the spring of growth. Few trees have to wait for rain before they produce all the signs of maturity except

the complete growth of their leaves. The bark of young seedlings, subject to fire, is very thick and corky and that of old trees is still more so, while the inner layers are fibrous and full of sap. Almost all species will coppice very well, many throwing up shoots up to 10 feet high in a season, others only a foot or two. Root shoots are also very common and a large number of what are apparently seedlings in the forest are root shoots. Most trees are anchored very firmly to the ground by lateral roots far longer than the height of the tree, a protection against storms. A tree which is completely ringed will often endeavour to join up the cut, meanwhile continuing its season's foliage, while the smallest connection with the root is sufficient for it to live for many years. Most new leaves, as a protection against the sun, are reddish in colour, many a brilliant crimson, the green being produced through all gradations of colour from the red. Others are hairy, scaly or covered with a bloom, the protective coverings wearing off with maturity. The proportion of sapwood to hardwood is large and many species show marked differences in this proportion according to their locality, some showing no heartwood in the north where it is produced in the south. The weights of woods are often considerably heavier in the north than is the case for the same species in the south. There are some localities where wide areas are infested with termites to such an extent that, during the dry weather their whole surface, even to the tips of the twigs, is completely covered with the earth carried by the termites. Although there are exceptions, it is observed that apparent damage is negligible and that the old scales are removed from the bark, exposing the fresh surface."

"The savannah species are, then, well equipped to withstand fire, drought, insects, wound, storms, and damage by man, and it can be imagined how readily they will supplant better types, since the harder the conditions the better adapted are the trees to meet them. The wide distribution of most species renders them more aggressive, and an individual species that will grow into a fine tree under the best conditions can still grow under the worst, though it may differ in form and feature so as to be hardly recognisable as the same species."

FORESTRY IN SARAWAK.

The Sarawak annual report for 1924 is rather colourless and suffers very much from the absence of a map. Without a map most of the numerous place-names in the report are meaningless, except to an inhabitant of Sarawak. Regulation of Management does not seem to have advanced very far, as the only note under this head records that parallel lines were cut across some mangrove forests so that data might be collected.

Under Silviculture there are a few points of interest. Eucalyptus of two kinds has been tried, and germinated well, but was eaten by caterpillars and crickets. Porcupines have also damaged seedlings of various kinds.

Improvement fellings were carried out over 55 acres, costing $181 with a view to the establishment of a crop of *Dyera* spp., *Sindora* spp. and the family *Anonaceæ*. At least that is what one gathers from the table of names given. The information is not very definite. A few sample plots were established and appear to be properly kept up.

The outturn of timber, etc., was roughly (in tons):—

Timber	...	23,000.
Firewood	...	41,000
Charcoal	...	2,700

A considerable quantity of minor produce was exported, export duty being charged, the principal items being Malacca canes, cutch, Dammar, Gutta, mangrove bark and rattans.

With regard to the Gutta Percha tapping the Conservator of Forests writes "In the vast majority of cases the native methods of tapping Jelutong ruin the trees. The cambium is penetrated, eventually admitting white-ants which kill the largest tree in a very short time. In the writer's opinion the blame for this lies at the door of the Chinese trader who rarely gives a fair price for the raw product. In consequence the native is forced to produce large quantities in a limited time to enable him to earn a living."

Extraction seems to be still primitive in Sarawak, judging from what the Conservator of Forests writes: "Prices of timber and fuel, especially in the Kuching district, are very high. One

of the principal reasons for this is the primitive method of working. The native wood-cutter will not fell any tree more than a chain or two away from a river bank, as all logs are man-handled. In the Federated Malay States buffaloes are extensively used for dragging timber and there are many contractors who do nothing else but drag timber for licensees at definite rates. Negotiations with one of these contractors to commence operations in Sarawak were in progress at the end of the year. If this method can be introduced it should lessen materially the cost of extraction. Buffaloes are already used in the north of the State but timber is worked in a very small way there."

The area of the State Forests is 253 square miles and the gross revenue of the Department was $99,600. As the expenditure was $67,700 the surplus was $31,900. The above comprises royalties, export duties on minor produce are not included.

EXTRACTS.

CREATION OF AN IMPERIAL FOREST SERVICE COLLEGE AT DEHRA DUN.

DELHI, 13TH FEBRUARY.

The Standing Finance Committee, at its meeting on the 11th February, granted a sum of Rs. 2,15,400 towards the institution of a training course for probationers for the Indian Forest Service, sanctioned by the Secretary of State. The training will be in the Forest Research Institute and College, Dehra Dun. It was proposed to convert the building of the Forest Institute into a college. The fresh capital expenditure likely to be incurred on this conversion, as well as on account of certain modifications and repairs in the residential quarters of the students, was estimated at Rs. 1,49,000 under "Civil Works" and Rs. 40,000 under "Forest" for the necessary furniture and equipment. The annual recurring cost of the training of probationers was estimated at Rs. 1,07,000. It was expected that the classes, including probationers from the Provinces, Indian States and other countries, would consist of

about twelve students per annum. The course will be a two-year one, and 24 students will, therefore, be in residence at a time. The present fees are Rs. 1,500 per annum per student for the Ranger class and Rs. 1,750 for the Provincial Forest Service class. The Secretary of State has accepted the proposal that it will not be justifiable to charge more than a fee of Rs. 2,400 per student per annum for the Indian Forest Service class, *firstly*, because it is hoped that by making the course comparatively cheap the Local Governments will continue to send their candidates for training even if in the future the forest administration becomes a Transferred Subject; and secondly, because excessive fees would prevent desirable private students from entering the Forest College.

This fee will include Rs. 300 on account of rent for quarters, light, water and other services, so that the actual fee for training will be Rs. 2,100.

The total fee, exclusive of rent, realisable from the 24 students will thus amount to Rs. 50,400 per annum against the recurring cost of Rs. 1,07,000, an annual loss of about Rs. 56,600. This deficit is likely to be a diminishing one. When this tropical college of forestry has established its name and the fact becomes widely known that at this institution instruction in forestry in its most advanced branches is being given demands for admission will, it is anticipated, come from outside countries. The only chance of making the proposed college self-supporting is, therefore, to establish its reputation and extend its activities beyond the training of officers for the Provincial Governments in India.

In addition there is the possibility that the Local Governments may take the opportunity of sending Provincial Forest Service Officers whom they intend to promote to the Indian Forest Service to undergo this course. In this way it is expected that the deficit will tend to decrease. It is also to be noted that of this deficit of Rs. 56,600 a sum of over Rs. 40,350 represents (*i*) part payment of the research staff which will be employed in any case, whether the training course is instituted or not, and an equivalent share of their pensions, and (*ii*) the pension of the new

instructional staff. So that the actual deficit in the annual accounts is not likely to exceed Rs. 16,250.

The amount granted by the Committee includes Rs. 26,400 for a portion of the year 1926-27 under recurring costs under "Forest." Nearly Rs. 1,50,000 represents capital cost.—[*The Pioneer.*]

DELHI, 24TH FEBRUARY.

The Secretary of State has accepted the Government of India's scheme for the creation of an Imperial Forest Service College at Dehra Dun, by expanding the present Institute, where Indian probationers for the Indian Forest Service will ordinarily be trained and facilities for private students will also be available. The Government hope to commence the training on or about the 1st November 1926. As the number of European recruits will be small, and as probably they could be obtained from the ranks of fully trained and qualified students of the forestry schools, the question of providing any further training for such recruits will, it is hoped, rarely arise.—[*The Pioneer.*]

LECTURE BY PROFESSOR STEBBING.

"RECENT PROGRESS IN INDIAN FORESTRY."

(Continued from pp. 104—117 of the March "Indian Forester, Vol. LII.")

As an introduction it should be stated that the method of working the forests for many years was by the so-called selection system and so-called improvement fellings. In practice what happened in the course of years was that many of the arge-sized trees of the few species which were marketable were gradually removed, leaving numbers of hollow or badly shaped trees in the forests, not worth removing, mature unsaleable species, and younger age classes which were very far from being ormal. The craze for revenue, shortage of staff, etc., was responsible. A realization of the true position of affairs now pervades the Department as the following brief notes will depict.

Bengal.—The chief progress made in Bengal, and it is considerable, is in the northern forests. For years the question of

obtaining satisfactory regeneration in the forests, both in the Darjeeling Hills and in the Duars Forests at their foot, had proved an enigma. In the hills the gradual removal of the larger part of the seed bearers of the valuable species led to a working plan based on artificial regeneration, the success being poor. In the plains *sal* forest it was at length realised that fire protection had resulted in the introduction of a dense evergreen growth which prevented the *sal* seedlings getting up. Various attempts were made at artificial reproduction at considerable expense and only moderate success, and then the *taungya* method was started on a small scale in Jalpaiguri Division in 1908 and subsequently on a larger scale in 1914. Mr. Russell had independently started successful plantations in the same manner at the Cinchona Gardens. This method, adopted in Burma years before, is to clear-fell and grow agricultural crops for two or more years, the cultivator putting out the young tree seedlings provided by the Department or sowing the seed at the stipulated time. The method met with instant success and is now practised in Kurseong, Jalpaiguri and Buxa Divisions, etc. These concentrated methods of regeneration pre-suppose sufficient labour, a demand for the material from the clear felling and adequate extraction methods. The operations at Sukna will be briefly described. A first consideration was a nursery, and here Bengal had the great advantage of having the Cinchona plantations in the province. Nursery work here had been reduced to a fine art, and the Bengal forest officers had the benefit of the advice of Mr. Russell, the Officer in charge. In consequence, when Blanford, from Burma, came to see (in 1922) the successful *taungya* plantations formed at Sukna, mainly since 1918 (for the real start dates from then), he returned to his province and said that the Bengal nursery work was the best he had seen, and paid Bengal the compliment of copying their methods. *Sal* is not the only species being used in the Kurseong Division. Others are *Gmelina arborea*, *Chikrassia tabularis*, *Bischofia*, *Terminalia myriocarpa*, *Bombax* and *Artocarpus*. At first the species used were put out in a haphazard fashion but the soil factors are now being considered, so as to avoid having large areas of pure plantations. I saw some wonderful

young crops of one year old *sal* sown six feet apart (three rows of seed 4 in. apart) looking like a crop of tea bushes, so good had been the regeneration. The material from the clear felling is collected to a centre by a skidder and then loaded into trucks and taken to the Darjeeling Himalayan Railway on a side line, which that railway constructs free of charge into the coupe. A small sawmill is in existence and a larger one is to be set up at Siliguri. These plantations have to be fenced with barbed wire in order to keep out deer, wild pig, etc.

Up the hill at Toong at an elevation of 7,000 ft. is situated a sawmill reputed to be the highest in the world. The same method is practised here, the logs are drawn to the mill by a skidder, sawn into planking and then sent down a wire ropeway 1,000 ft. to the railway and cartroad. The success of the work here is due to Shebbeare, Conservator, W. E. Hodge, Divisional Officer, and G. W. Houlding, Forest Engineer. Some of the men working here are old porters of the last Everest Expedition, and are ready to set out on the next one. Shebbeare was himself a member of the last expedition. The chief species being planted up here are Utis (*Alnus nepalensis*), Pipli (*Bucklandia populnea*), Walnut and *Cryptomeria japonica*. At Takdah, in the Darjeeling Division (5,000 to 6,500 ft.) *Cryptomeria japonica* plantations are being made in the same fashion, all planting since 1919 having been done free by *taungya*. No weedings are necessary.

The formation of plantations by the *toungya* method was not new to Bengal. In the early seventies of last century teak plantations had been formed at Kaptai on the Karnafuli River in the Chittagong Hill Tracts. These were destroyed by a cyclone in 1897. In recent years they have been recommenced.

Assam.—The show division in Assam for some time past has been Goalpara situated to the east of the Buxa division, which includes some of the finest *sal* forest in this part of India. In the past the difficulty of exploiting the *sal* was due to the absence of water in the forests. The building of a short length of tramway by Perrée in 1905, helped to solve this difficulty. In recent years this line, which started from Kochugaon into the

forest, has been lengthened and converted into a steam tramway. The line now runs 17 miles through the open country to connect with the railway, and there are many miles of branches into the forest where exploitation is in full swing. In 1906 there was only a mud thatched roof hut at Kochugaon. Now there are a dozen good bungalows for the staff, a post-office has arrived, and a sawmill and engine sheds have been erected. The whole of this work has been undertaken by the Department, including the building of some difficult bridge work over the rivers. Messrs. Meiklejohn and H. P. Smith have been responsible for a good deal of the recent work which has transformed this rather remote spot. Concentrated regeneration by *taungya* is being commenced here. It is also in force in Sylhet and Cachar, where some excellent work has been carried out in the past five years. In fact, the great extension of this type of regeneration dates from 1919 in most provinces, except Burma.

Burma.—It has been mentioned that the *taungya* method commenced in this province, having been suggested by Brandis when he was in charge of Pegu between 1856—62. For years teak plantations were formed in this fashion, but without any co-ordination; thus many got lost to sight and were never thinned. In 1905 in Pegu, Lace drew attention to the position, and as a result Government practically put a stop to this practice in 1906, improvement fellings of a more advanced type being prescribed. The first attempt in Burma to work a forest under concentrated regeneration was made in the Katha Division. Since natural regeneration was not obtained readily, resort was made to artificial *taungya* work. It was recognised that when seed bearers were insufficient, artificial regeneration would become necessary to obtain complete stocking. The work carried out here was of value since it taught the forest officer the value of regulated *taungya*. The general return to *taungya* came in with the Tharrawaddy Yoma Working Plan in 1918, and has spread to other divisions. The rapid extension is indicated by the fact that on June 20th, 1924, the area of *taungya* plantation was 98,740 acres, showing an increase of 20,000 acres in the preceding six years, as compared with an increase of just over 1,000 acres under *taungya* plantation in the preceding eleven years. Teak is not the only

species utilised. At Tharrawaddy *Xylia dolabriformis* (pyinkado) *Terminalia tomentosa* and *Pterocarpus macrocarpus* (padauk) and several others are put out. Mr. H. R. Blanford, now Conservator of Working Plans, has been responsible for much of the recent work here, and in his company I saw some magnificent young crops last February. This division, with Zigôn and Prome, is worked departmentally and the material is sent down to Rangoon, where it is dealt with by the Utilisation Conservator, Mr. W. A. Robertson. The latter is an expert in Utilisation and has a fine sawmill, seasoning plant and workshops in Rangoon. The transit of the teak logs has been greatly facilitated by the river training works instituted by Messrs. F. A. Leete, C.I.E., and G. C. Cheyne, which have confined the streams to definite beds on leaving the hills. Another remarkable piece of recent work carried out in Burma has been the inauguration of aerial forest surveys. Two such surveys have been accomplished—the first in 1924 for the Irrawaddy Delta forests and the second (1925), a more difficult undertaking, for 1,400 square miles of unexplored forests in hilly country in South Tenasserim. The idea originated with Mr. E. F. A. Hay, I.F.S., but it was Mr. H. W. A. Watson, now Chief Conservator, who pressed the Government to make the attempt. Success has been achieved in a remarkable manner.

Bihar and Orissa.—In three of the Chota Nagpur (Singbhum) Divisions, Saranda, Kolhan and Porahat, the regeneration of *sal* presents no difficulty over considerable tracts. The system now applied, formerly termed the Uniform System, is in reality Clear Felling. The old *sal* crop is felled, clumps of good young poles being formerly left when present. The modern procedure is to cut out the poles and then burn the area in early April. The prolific young *sal* regeneration is burnt down, but the roots are not killed, and strong shoots are sent up from beneath the surface. Mr. Nicholson, the Research Officer of the Province, with whom I inspected the method, states that an even dense crop of young plants, seedlings and coppice, is thus obtained. In Sambalpur parts of the forests are worked under the coppice system with excellent results. There is also an excellent example of the Strip System.

Central Provinces.—The Raipur *Sal Forests, which* are to be opened out by a new 2 ft. tramway and for which a new working plan is in the press, are to be worked under the Uniform System, natural regeneration being abundant. *With this exception, and* an area of *Pinus longifolia* plantation which is showing remarkable growth, the Central Provinces forests are worked under the Selection System. Sir Henry Farrington, Bart., the Chief Conservator, has within the last few years placed the Improvement Fellings on a proper basis, each coupe being now thoroughly worked out and the necessary thinnings carried out before being left. Some of this work is now departmental. There is little doubt that the forests have greatly improved since Sir Richard Temple's day, but progress has lagged behind. In Farrington's company I visited the fine Allapilli Teak forests, which have been known for a century. The improvement felling and thinning work in one working circle and the exploitation of the fine teak in the other proved most interesting. The latter has to be carried out with care since the logs have to be carted 80 miles by road to the depôt and sawmill at Ballarshah on the railway. The organization of the Allapilli scheme is a good example of modern development.

Madras.—There are several interesting studies to be made in Madras. The Gumsur *Sal* Plan is reminiscent of the method of working the *sal* forests in Chota Nagpur, except that having removed the old growing stock and burnt the refuse, the young regeneration is then cut back so as to obtain an even dense young crop. The famous Nilambur Teak Plantations are worked on the clear felling and artificial restocking method. There are one or two problems here The chief perhaps—Will a second rotation pure crop produce as good results as the first now being cut, and would it not be better to interplant or underplant with a species such as *Hopea?*

The most interesting place to visit in Madras is the Palghat evergreen forests up to recently regarded as inaccessible to exploitation. A sawmill and seasoning kilns (to season the soft woods) have now been erected at Olavakote on the railway, and in the forests some eight miles away in difficult hill country

the marketable trees, some of gigantic dimensions, are being felled. The exploitation works here are most up to date. Broad roads, beautifully graded, have been driven up the Sappal Valley to near its head, an upper and a lower one. By using powerful tractors, skidders and gyn poles, usually trees selected at definite spots along the roads, the logs are hauled up on to the upper road or down to the lower one. The great schemes in force here were inaugurated by Messrs. S. Cox, C.I.E., and H. Tireman, C.I.E., Chief Conservators, and the wonderful way they are being worked is due to Mr. Martin, Chief Forest Engineer and Major Chipp, D.S.O., M.C., who is in charge in the forest. A *Terminalia tomentosa* felled had a diameter of 7 feet at the point of junction of two branches. The lower log weighed 10 tons and contained 280 cub. ft. The two logs above the fork contained respectively 160 cub. ft. and 120 cub. ft. These logs were yarded up a slope of 22°! Other valuable species here are *Mesua ferrea, Hopea parviflora, Dysoxylum malabaricum* and *Artocarpus hirsuta*. The regeneration of this type of evergreen forest requires some overhead cover. Present experience seems to show that when all marketable trees have been cut out, and only such are felled, the cover left is sufficiently heavy to protect the young regeneration. This latter is either natural, if sufficient valuable species are present in the overwood, or is assisted artificially. An adequate description of the fine work being carried out in these great forests would require a paper to itself. The work is all under the strictest supervision, stock maps are available for each compartment worked in, and daily records and commercial accounts are kept. Tireman and Minchin have studied the silviculture of the Coorg forests which are similar in character and are also being worked.

Bombay.—In the North Kanara Teak forests a somewhat similar exploitation scheme is in force under Mr. A. C. Hiley, though not on the same colossal scale. The tractor is a Fordson, and in one place the American device of a buffalo-winch is in use for hauling logs on to the road. Under Mr. Pipe, Superintending (Forest) Engineer, a co-ordinated scheme of roads and buildings has been devised; the sawmills in the province are all

under his charge, and in the North Kanara *working area* at Dandeli he has probably one of the largest and most replete depôts in the Forest Department in India, with workshops, drying sheds, store rooms, etc. Another point of interest is the present management of the forests which are not capable of producing large-sized teak timber. During the earlier part of the century and until comparatively recently these had been managed as coppice with standards. Areas of this kind exist in Thana, Belgaum and Dharwar. The proceduce now is to treat them as pure coppice on a rotation of 40 years, the better types of forest being on an 80-year rotation. After clear felling, the material remaining consisting chiefly of brushwood under 6 in. diameter (above that size is converted into charcoal) is spread out in patches and burnt; only these patches are either sown with teak seed or planted up. This supplements the crop of teak coppice shoots coming up from the stools, which are carefully trimmed. The demand for the coppice coupes is large and the contractors thus readily undertake to carry out the rules in force on the subject of exploitation and cleaning, etc., in the coupe. The work seen here in company with Mr. A. G. Edie, the able Chief Conservator, Mr Newman, Conservator and Mr. E. A. Garland, Divisional Officer, merits high praise.

United Provinces.—These provinces took the lead in breaking away from the old selection system and introducing regeneration under the Uniform System and also coppice with standards. They were also the first to introduce experimental thinning of bamboo clumps. The regeneration of the deodar for years gave difficulty, but the Uniform System is in force in the hills both here and in the Punjab and intensive working plans exist, some of the best in India, for the Himalayan forest of deodar, blue pine and the *Pinus longifolia.* In the Dun forests the Uniform System is in practice, but the new crop, obtained with success, is really a coppice growth under a shelter wood. When all material has been removed the refuse is burnt in April and the new crop comes up during the next rains. The amount of overhead cover to leave is still in doubt. And this is even more the case in the fine *sal* forests of the Terai divisions of Haldwani and Ramnagar

Since 1914, when Collier introduced the Uniform System into the Haldwani Division experiments have been taking place here in which, Collier, Troup, Trevor and Smythies have all taken a hand. The difficulty experienced is that if the cover is opened out too early a dense weed growth supervenes and kills out all the young natural regeneration of *sal* which, only a few inches high, thickly clothes the forest floor. If the cover is kept dense the *sal* persists but does not grow. Frost is the danger here, and therefore, clear felling is impracticable. An effort was made to weed in the rains, The malaria is, however, so bad that most of the gang engaged died before the ensuing cold weather was over. Early burning or a double burning, the first to get rid of grass and a second as soon as the leaves are on the ground, is now being undertaken by Smythies. So far certain success has not been achieved. It was suggested that annual early burning for five successive years before regeneration was required might destroy the weed growth sufficiently. A tramway has been laid down in this division to facilitate the extraction of the timber, and has just commenced functioning.

A division which has achieved notoriety is Gorakhpur, the *sal* forests of which produce a very high net return per acre. The system here is clear felling, the resultant crop being coppice shoots. Originally the system in force was coppice with standards —but the fellings in the standards between 1893—1913 were too light and the coppice was suppressed. The 1913—23 clear fellings have given excellent results on areas where there was suppressed coppice or advanced growth. Where this was absent Mr. Wood commenced clear felling with *taungya*. This has been so successful that the 1925 working plan will prescribe a modified system of clear felling to all the *sal* forests of the division. The United Provinces have the honour, on the recommendation of Clutterbuck, the Chief Conservator, of having appointed the first conservator of Working Plans (1920) and Utilisation (1919) in India. The latter gave rise to the installation of the sawmill, wood working industries and rosin factory at Cutterbuckganj.

A word must be added on the Afforestation Division. This work was commenced on the howling waste of hot ravine lands

bounding the Jumna and stretching from Cawnpore to Agra and away to the east. The lands had become barren owing to the sinking of the bed of the Jumna and the scouring out of the soil into deep ravines during the heavy monsoon rains ; the area is swept by fiery winds in the hot weather. It was due to Sir John Hewett that the attempt to afforest these lands was commenced in 1912, although Mr. Fisher, Collector of Etawah, had planted up an area some years before. During the first few years the work was purely experimental—Mr. Courthope being in charge. By 1919, however, success was assured. A bad famine occurred that year. It was then determined to start work on a large scale, and famine relief labour was put on to the work of preparation of the soil, which consists in making embankments and bunds or ridges and trenches. Seed is either sown or root and shoot cuttings made use of. The chief species now used are *Dalbergia Sissoo, Acacia Catechu, Albizzia Lebbek, Butea frondosa* and bamboos. The success achieved is almost incredible, as the slides depict. About 12,000 acres are now afforested and private owners are following the Government's example. Already the division supplies about 44,000 maunds of grass, and, on a small scale, firewood. About 2,300 acres are planted annually. This is perhaps one of the most remarkable pieces of afforestation work that has ever been undertaken, even more remarkable than the planting up of the sandy tracts of the Landes by the French Government for long considered to be the classic example.

Punjab.—The revival of silviculture in the Punjab was due to Mr. C. P. Fisher who became Conservator in 1907. In the hills the break away from the Selection System was made with the adoption of the Group method in a plan for Chamba. This was unsuccessful and the subsequent plans for the hill forests have been on the Uniform System In the plains the most important feature in connection with forestry during the past decade and a half has been the great extension of the irrigation schemes and the opening out of the large canal colonies, with the result that large parts of the "rakh" area or waste scrub lands have been made over by the Department for cultivation. In 1894-95 nearly 700,000 acres were under the Forest Department. In

1924-25 the area was only 96,000, 600,000 acres having been made over for cultivation. In their place it has been necessary to make plantations in order to provide for the requirements of the new population. Changa Manga, the first irrigated plantation, now in its 3rd rotation (of 20 years), is suffering badly from a fungus attack (*Fomes lucidus*) which almost threatens annihilation. Mr. W. E. Fluett, the Divisional Officer, is starting *taungya* cultivation in the hope of eradicating the spores from the soil when root and shoot cuttings of Sissu will be made use of. Eucalyptus is also being experimented with. A tramway has been laid down connecting the plantation with the railway, and this greatly facilitates extraction of the material from the coupes. The new plantations now in process of formation are the Chichawatni plantation, 12,000 acres, commenced in 1912-13 (where a tramway is to be built), and Khanewal, 19,000 acres (started in 1916-17) to supply the colonists of the lower Bari Doab Canal. In 1919 Daphar, 7,900 acres, was opened on the tail of the Upper Jhelum Canal. The Tera plantation of 800 acres was formed to provide fuel for the rosin factory. Finally a much larger project is to be taken up, the Government having promised an area of 30,000 acres in the New Sutlej Valley Irrigation Project which is being investigated. The growth of some of the young crops is remarkable and the value of these plantations both economic and financial promises to be very great. The work of the Irrigation Department in the Punjab, especially the great development of the past decade and a half, is a wonderful achievement and furnishes an illustration of the great work the British Government has done for India. Great stretches of country which were barren wastes a score of years ago are now, in April, covered with golden fields of grain. With the increase in cultivated area other plantations will be required, and it appears as if the important work of the Department in the Province will shift from the hills to the plains. In the hills of recent years considerable improvements have been made with extraction methods and the wire rope has come into far commoner use, Mr. Donald's patent having facilitated its employment. One of the outcomes of the war was

the great demand for rosin, and the tapping of the *Pinus longifolia* in the immense tracts of this forest, both in the Punjab and the United Provinces, has opened out a great industry, the former having a rosin factory at Jallo.

One of the points which impressed me most in connection with the professional work during my visits to the different provinces was the urgent need of determining generally how the gigantic amount of thinning work in the young crops, now multiplying rapidly, was to be undertaken. By what agency and with what amount of training in this, the most important, as it is the most difficult, of the duties of the forester to be accomplished. This is far too big a subject to enter on here. But it appears that if this work is to be done properly it cannot be left to (in this matter) semi-trained subordinates. In fact it is one of the most important duties requiring the direct supervision of the Divisional Officer. A far larger staff will be required than exists at present if the young crops, let alone the Improvement Fellings and thinnings of the large areas still under the Selection System, are to develop into mature timber of good class and stocking. This is the opinion which was forced upon me. With a few exceptions, the new position which has arisen with the great advance in silvicultural practice, does not appear to have been adequately realised by the Department as a whole. Yet Indian Forest Officers will readily agree that it is a problem of the first importance.

The progress made in Working Plans during the present century has been considerable. Provinces such as the United Provinces and the Punjab have the greater part of their forests under plans, many of them as well drawn and intensive as those to be found in continental Europe. Other provinces are not so well advanced, Assam and the Central Provinces being backward in this respect. The Presidencies of Madras and Bombay, when it is remembered that forest conservancy commenced in this part of India, are by no means as advanced as could be expected. Some examples of intensive plans may be mentioned, one or two of which have been already alluded to. Many plans show the departure from the so-called old Selection treatment with the equally so-called Improvement fellings. We find the Uniform o

Shelter Wood Compartment system prescribed in such different types as, *e.g.*, the Kulu Hill forests in the Punjab, the Terai *sal* forests in the United Provinces, the new Raipur *sal* forest plan in the Central Provinces. What may be termed a modification of the system is the prescription to clear fell over existing young regeneration prescribed in the Porahat, Saranda and Kolhan working plans in Bihar and Orissa ; and the further modification in the Gumsur *sal* forests (Ganjan) plan. Concentrated regeneration by the *taungya* method forms the basis of several working plans in Burma and is being followed in Plans for the N. Bengal Divisions, in Assam and elsewhere. Clear felling with artificial regeneration by sowing or planting is the basis of the Thana working plan (Northern Circle, Bombay), as also in the Yellapur and Mundgod High Forest Plan, a good burning of the rubbish before bringing in the teak being essential. The Nilambur Teak plantations plan by Bourne is based on similar lines. Coppice plans as, *e.g.*, Sambalpur, Ootacamund plantations and elsewhere, and coppice with standards are in existence in many Divisions.

In connection with the supervision of Working Plans and other matters of policy it will now be of interest to consider the present position of the Central Government with reference to the Forest Estate in India. Formerly the Government of India decided upon the general forest policy of the country except in the case of Bombay and Madras where they only tendered advice. To understand the present position it will be necessary to review several important acts of procedure. In 1911 alterations in the terms of the then existing provincial settlements with the various Local Governments were introduced. The chief object of these alterations was to convert a portion of the large fixed assignments which most of the provinces then received from Imperial revenues into an additional share of growing revenue. Under this arrangement Forest revenue and expenditure, as well as refunds, were made wholly provincial. The permanent provincial settlements applied to Madras, Bombay, Bengal, United Provinces, Punjab, Burma, Eastern Bengal and Assam (now Assam, and Bihar and Orissa) and the Central Provinces. It is at least open to serious doubt whether the inclusion of Forest revenues in the new policy

was a wise step since the holder of the purse is in the strongest position, and there are certain factors in connection with a forest policy for the country as a whole which should remain in the hands of the Central Authority. The Inchcape Committee's report, although it appeared to deal with the whole Department, really only referred to the Headquarters, Surveys Research Institute, Home Expenditure and the Forests of the N.-W. Frontier Province, Coorg and Andamans—a mere fraction of the Forest Estate of India. One of their recommendations was the abolishment of the post of Inspector-General in whose place a "Manager with commercial experience in the timber industry assisted by the necessary technical experts," should be appointed. This recommendation shows a want of appreciation of the true functions of a Forest Department in a country. It is no secret that the question of retaining the post of Inspector-General has been under consideration for some time past. One argument is that as most of the provinces now have a Chief Conservator, an Inspector-General is superfluous. But the former at the most can only usually have experience of two provinces. They could not possess the wide experience of the Inspector-General and they are directly under their own Local Governments. It is said that if the forest became "transferred" in all Provinces the Central Government will have no further voice in their management. Burma and Bombay have already transferred their forests which are now under an Indian Minister. For various reasons neither forms a precedent for the rest of India to follow; and many think it will be a bad thing for the country if the step is ever taken. But even if it were, could the Central Government ever contemplate disassociating itself from the control of general forest policy in a country such as India? The history of most of the Forest Countries of the world furnishes evidence that when a forest policy common to the country as a whole has been absent, sooner or later waste and bad management inevitably supervened, terminated at length by the Central Authority taking charge. The Forest Department control an area of 224,000 square miles of forest or about 20% of British India. The Revenue for 1922-23 amounted to Rs. 5,52,14,000 (approx. £4,247,000)

and the Surplus to Rs. 1,84,24,300 (£1,417,000). Decentralization in forestry matters at so early a stage in the new form of Government would at the least imperil the fine work of 60 years and might well spell disaster. Such matters as the control of mountain forests and catchment areas of the great rivers in order to safeguard costly irrigation schemes, power works and so forth, which may be hundreds of miles away in another Province, serve as one illustration. India suffered badly from floods which caused enormous damage both in the north and south during the rains of 1924, directly attributable to excessive fellings in the past in the hill areas. The Forest Budgets are now in the hands of the councils. There is one possible check which a definite forest policy can look to and that is the Working Plan. Here again the history of the past 15 years is disquieting. In 1910 the Royal Commission upon Decentralization made recommendations on the subject of Working Plans in which, broadly speaking, they suggested that the full control then possessed by the Inspector-General should be relaxed, and that only in the case of plans for any "large area," an ambiguous expression when applied to a working plan, should the Inspector-General be consulted, and that the forwarding of Control Forms to his office was superfluous. It should be mentioned that with the appointment of a Chief Conservator in Burma in 1905 and later in the Central Provinces it had been decided that the management of all sanctioned plans and checking of control form should be left to those officers. As a result of the suggestions of the Royal Commission and proposals of the Government of India submitted to Local Governments for their opinion it was decided that in future in provinces where there was a Chief Conservator the Inspector-General would have no concern with the preparation of Working Plans unless the Local Government desired his opinion. In provinces where there was no Chief Conservator the procedure previously in force would continue. Copies of sanctioned plans would be sent to the Inspector-General and he could point out any defects to the Local Governments. Copies of control forms were to be sent to the President, Research Institute, for use in the Silvicultural Branch. By 1921 only three provinces, Bengal, Bihar and Orissa, and

Assam were without Chief Conservators. In their case the procedure was modified in a letter of October 1921, which intimated that "all such reports need not, in the ordinary course, be sent to the Inspector-General of Forests. He will always be glad to examine working plans for them if so desired, but reference to him in future will be optional."

In a precis drafted on the past history of Working Plans (appearing in Government of India *Notes—Forests*, June 1910), the following extract seems to contain the crux of the present position. "The points for consideration therefore are whether the time has now arrived when the *Control* Check exercised by the Inspector-General may be relaxed partially as the Royal Commission proposes, and whether it is desirable to do so in the present state of forestry in India. The Government of India exercise control over the State Forests through the Inspector-General who is at present responsible for the recommendation to Local Governments of ***suitable systems of management of the State Forests.*** If this responsibility is not to be decreased it is evident that every *plan should be seen by the Inspector-General before it is approved.* The present system is advantageous both to the Local Governments and to the Inspector-General; to the former especially because they will have the varied experience and wide knowledge of the Inspector-General at their disposal, and to the latter because of his responsibility in the matter both to the Government of India and to the Local Government." These sentences were written by a man who had the clear vision of the responsibility of the Government of India *vis-à-vis* the State forests. *Has that responsibility* been any whit lessened by the introduction of the Reforms? Is it not a heavier burden and a greater responsibility to-day than was the case in 1910? Until Local Legislatures and the Legislative Assembly itself have become more informed on matters relating *to national forest policy can the Central Government deprive* itself of an expert on whom they can rely for suggestions and advice? *And can the* Local Government do so? The Inspector-General recounted to me in Simla that almost the first step taken by the Bombay Government after the forests were "transferred," was to *invite* him down to advise them.

The decision on the subject of the post of Inspector-General had not been arrived at last May. Extensions have been accorded to Sir Peter Clutterbuck in order to give time to come to a decision. To some extent assistance may have been anticipated from the Lee Commission's report. But that Commission appears to have regarded with equanimity the transfer of the forests to Provincial Ministers. But there are Provincial Administrators who by no means take this view. One experienced Governor told me that he viewed such a policy with grave concern. The Lee Commission, he said, included no expert member conversant with the forestry question or the real vital necessity of the forests to a country like India; nor of the need of a co-ordinated forest policy laid down and jealously guarded by the Central Government. It is I believe correct to say that none of the recent Commissions in India, the 1910 Royal Commission, the Islington Commission, the Inchcape Committee, the Lee Commission (with the exception of Sir Reginald Craddock) and last the Muddiman Committee of 1925, included a Member with any expert forestry knowledge. It was with surprise that one learnt that the majority of the Muddiman Committee recommended that the forests should be transferred to the control of Ministers in all Provinces on the plea that the example had already been set by Burma and Bombay, though in neither case has there been time to show the wisdom of the action.

At Simla I had the opportunity of discussing this and other questions with Mr. J. W. Bhore, C.I.E., C.B.E., the very able Secretary, Department of Education, Health and Lands.

How the Government of India was to maintain the necessary control over Forest Policy is admittedly a difficult problem in view of the fact that they have given up the control over finance, and more important still, Working Plans. The problem does not, however, appear insuperable. The idea being considered was the possibility of amalgamating the posts of Inspector-General and President of the Forest Research Institute. This would remove the Inspector-General from the Headquarters of Government but in these days of motor cars that would not be a great matter since Dehra Dun is comparatively close to Delhi and

Simla. The amalgamation of the two posts, however, would render one of them nugatory. The Inspector-General's function is to tour constantly. That of the President is to maintain supervision over the Research Institute and College. With the recommendations of the Legislative Assembly and Council of State to train Indian recruits for the Indian Forest Service at Dehra it would be more than ever necessary for the President to remain at Head Quarters. It was suggested that if the Inspector-General were transferred to Dehra and made President of the Research Institute there should be a Vice-President in charge of the Institute and College, the extra cost being well worth the object to be gained. These matters are, however, secondary. It would appear of the first importance at this juncture that the Central Government should, after a careful consideration of all the factors coming into play, definitely announce a forest policy for the future in order that the Local Councils may know exactly how far they can go and where their authority over the forests ceases and that of the Central Government comes into action. It is owing to the vigilant care of the Government of India and the Secretaries of State that this magnificent Forest Estate has been brought to its present condition. My conversations at Simla led me to hope that the Government of India are fully alive to their great responsibility.

DISCUSSION.

Sir Charles Low, K.C.I.E., said he had had some difficulty in following a technical ex-officer of the Forest Department, he himself being a retired officer of the Indian Civil Service. He had spent a good portion of his service in a province which consisted mostly of jungle and he believed it was generally considered very poor jungle, the Central Provinces. When he first went through an Indian forest he had a feeling of intense disappointment at its very uninteresting appearance, but when he began to talk to the *jungli*, who was showing him round, he soon found that it was a great deal more interesting below the surface. He asked the names of the different trees and what they were used for, and every one, apparently however much alike and however uninteresting their appearance, had a different use. One kind was good for ploughs, another for cart wheels, another for yokes, and, as his guide informed him, others were fit for nothing but burning, and there were some that were good for destroying bugs in beds, and those were much appreciated

The general impression he obtained was that the species differed very much from species in England in that they were all very highly differentiated. They were grown under a tropical sun with different conditions of climate and soil from those of England, and they were put to more various uses, and some of them contained a number of potent drugs or scents. He was brought into rather disagreeable contact with the poison productiveness of one species when a lady tried very hard to poison her husband with something she had obtained out of one of the plants: but curiously enough the Government Analyst, to whom the stuff was sent, could not detect any poison. Some years afterwards he was able to send specimens of the tree to an organic chemist, who discovered that it contained a powerful glucoside which previously had not been known. The possibility of those highly differentiated powerful scents and drugs existing in so many parts of the Indian forests was now beginning to be examined, although he understood that Dehra Dun had had to go slowly in connection with forest products owing to the expense; but, as Professor Stebbing had said, they had spread themselves out on all important matters and probably they were only just in time in doing so from the economic point of view. India for the last few years had been in the position of being very tightly pressed for forest products. It was anticipated that the possibility might arise of India having to provide those needs which her own forests could not supply by going into the world markets in competition with other richer countries and she could only be saved from that by very careful exploitation of her own resources in every possible way. He had noticed how Italy dealt with one of the problems. In the poorest communal forests bundles of firewood were placed on a ropeway, the larger and better-managed one having strong wire ropes. There were occasional accidents, but nobody appeared to mind, as the people obtained firewood very cheaply. For a great many years the Indian Forest authorities concentrated their main efforts on limitation and conservation and on local rights, crystallising those rights as far as possible, and making it as easy as possible for the people who lived near the forest and depended very largely upon it for their requirements to get what they required. Therefore, when more modern ideas began to prevail and the Forest Department were allowed to do what might be called economic research and make an attempt to develop what they had in the forest in every possible way, they had a more or less definite property to deal with, and it was as free as circumstances would admit from the troublesome but very proper and necessary rights. Things were getting better in the way of supply of forest products. He had been asked recently whether he thought there would be a market for woods from the evergreen forests in the south of Chili if sent to India, as sleepers. Even in a province like the Central Provinces, which

contained a great deal of wood, he found, when in charge of an Exhibition in 1908, that it paid him better to get Australian jarrah wood from Bombay than to buy the local wood, the condition being that he had to resell as much as possible after the stuff had served its purpose. The importation of wood from Australia into India was not so large as it had been The sleeper problem was being dealt with at Dehra Dun by the use of preservatives, and the railways made more use of iron and concrete sleepers.

He thanked Professor Stebbing for his brilliant presentment of the manner in which the Forest Department in India were reacting to the present economic pressure, and for the delightful photographs which he was sure would recall to many present the pleasant days spent in various parts of India.

MR. Walter F. Perrée, C.I.E., congratulated the author on the excellent use he had made of his opportunities. Mr. Stebbing was the first Forest Officer employed on research work, the branch of forest entomology being the first to be created, well in advance of the Forest Research Institute. For years Mr. Stebbing worked quietly and gained a vast amonnt of information and made a general review of entomology as applied to Indian forests, and the Department had greatly benefited by his work. Many people envied his vast fund of information, and he thougnt the Department as a whole owed him a debt of gratitude for setting himself the task of recording progress from beginning up to the present time. The two volumes which had already been published were intensely interesting to all forest officers, and he was sure the third would be even more so. It might, perhaps be inferred from the lecture that progress in forestry was comparatively recent, but he should like for a moment to follow the development of forest conservancy in India. It was started about the middle of last century, and, therefore, had been in existence for some 75 years, a very short period in the life of a forest. In the museum at Dehra Dun there was a section of a deodar tree which was a fine pole when William the Conqueror landed at Hastings. It would be seen, therefore, that the Department had had very little time in which to exercise much influence on the forests of India, but no time had been wasted. The first sixty years were devoted to the constitution of the forest estate. The forests when taken over were by no means all magnificent virgin forests, only a very small proportion being in that condition. The majority consisted of ruined forests in which man, cattle and fire had held sway, and most of the crop was in a miserable condition. Apart from the reservation, demarcation and survey of the forests the early professional work of the Department consisted in restoration, and it was a very magnificent work. It was the preparation for what

Professor Stebbing had described. Whether or not the progress was the result of the development of forest research or *vice versâ* it was very difficult to say, but there was no doubt that when Eardly Wilmot became Inspector-General there was, within the Department, an insistent demand for better professional work. Attention had then been directed towards doing something of a really technical nature for the forests, and, fortunately, Wilmot came forward. He realised that to achieve that end several things had to take place. First of all, he had to reorganise the whole Department, province by province, so as to get the staff and the division of charges in such a condition that the work could proceed. Then he realised that the scientific side had to be provided for in the form of a Forest Research Institute. He was doing for forestry what had already been done for agriculture. Since those days the need for research had been emphasised, principally, by the war. Sir Thomas Holland might recollect how he urged the Department to produce more and more turpentine, even at the risk of burning the whole distillery down. The kettles were reduced to the thickness of a sheet of paper, but it was necessary to go on. That, and demands for timber and other products required to prosecute the war, made it clear that the Department had not provided as yet sufficient means for dealing with the problems of the country, and therefore, immediately after the close of the war they had set to work to deal with matters on a larger scale, and he thought the scheme as it now was would provide for future requirements for some time to come, as it admitted of great expansion. There had been difficulties. Finance had been insistent for the last five or six years and the programme had to be very much curtailed. When it came to bringing the cost of the work down to a definite figure, sacrifices had to be made, and, with the help of his friend, Mr. Pearson, certain branches were reduced to a skeleton basis, but timber research had to be provided for, and, therefore, they did what they could to maintain the research in timber which, fortunately, they were able to do. Minor products had to go. The branch of minor products would eventually be quite as large as the branches dealing with timber. That the Department had been fairly successful the author had made clear by his remarks voicing the opinion of the Chief Commissioner of Railways. It was most gratifying to the people of Dehra Dun last year to be able to entertain the Congress of Chief Engineers of Railways. There had at times been some friction with regard to the supply of sleepers, but it was only necessary to bring the people together to discuss matters to smooth over all the difficulties. Since that time a Forest Officer had been appointed as a Liaison Officer between the Railways and the Forest Department.

With regard to matters of research, in early years little more was done than collecting available information, but research if it

was to be of any use at all, must not only march with, it must anticipate the public and departmental demands. At one time in Dehra Dun they were compelled to obtain much information from outside, but that was not what a Research Institute could tolerate. They had to anticipate things so that anyone who came to the Department could be supplied with the required information. Professor Stebbing had very wisely omitted to deal with the difficult question of forest education. Those in India, especially Indians, would agree that the matter of forest education was as important as forest research. The greater part of the staff in the Upper Subordinate and Provincial Services had been educated at Dehra Dun, but whatever was decided upon must of necessity take a little time. India was now in a state of transition. It was not quite clear what the functions of the Central Government were to be towards local governments and that had to be decided before the other question could be dealt with. He hoped, however, that the wise counsels which had prevailed in the past would continue in the future, and that the forests would not be dealt with purely as a matter of local politics.

Mr. Ralph S. Pearson said he had not much to add to the author's admirable exposition of the development of the forest in India in recent years, but it might be of interest from the point of view of history to record who was, in his humble opinion, one of the men who did more for the Forest Research Institute at Dehra Dun than anybody else. One of the greatest difficulties was finance. At the critical time of 1913, when the new building was under contemplation a Revenue Member of the Government of India, Sir Robert Carlyle, fortunately had a very shrewd idea of what could be done with research and helped to obtain the money. The real difficulty was overcome at the time by Sir Robert Carlyle, with the help of Mr. Mercer. When the Department began to have all sorts of visions in mind as to further expansion in 1917 and 1918, the question of money again cropped up. It was a matter of a large sum because it was decided that 1,300 acres were necessary for the Research Institute and College, and on that occasion the Department was greatly indebted to Sir Claude Hill. Fortunately at the two critical momemts when research might develop there were two members who appreciated the effort of the Department. The author had very rightly said that generally speaking, research in forest utilisation was roughly divided into three parts: the preliminary laboratory experiments, followed, secondly, if those experiments showed that there might be something arising from the investigations, by larger experiments, and thirdly, the most difficult business, the translation of laboratory experiments, either small or large into a commercial proposition. For that purpose it was found very soon that

something more than a Research Institute was necessary if the work was to be of real value. Utilisation Circles in the Provinces were inaugurated, the first being started in the United Provinces. That at once created a liaison between the work done at the Institute and the various officers actually engaged on utilisation subjects in the provinces, and also, to a large measure, bridged the difficulty of bringing the Department in touch with the commercial world. There should be a liaison officer between the utilisation circles and commercial circles and the Research Institute. The railways had appointed such an officer, but the provinces had still to do so. The United Provinces had a Divisional Provincial Officer of Supplies, but owing to want of money, that post had to be abolished. Such officers would be necessary to pass on the information which the actual research officers could not do. Reports were written but commercial men did not read them.

Sir Reginald Craddock, G.C.I.E., K.C.S.I., said the two provinces with which he was most closely associated were the Central Provinces, of which he was Chief Commissioner, and Burma, of which he was Lieut.-Governor, and therefore, perhaps he had had as good opportunities as anyone in India of seeing the work that the officers of the Forest Department did and of appreciating their great value. It was with much reluctance that he was a consenting party to the transfer of forests in Burma to the category of transferred subjects. The local issue was very important there at the time and stressed very strongly, and he found, even among the senior officers of the Forest Department, that instead of opposing transfer there was a good deal of opinion in favour of it. He believed it was generally thought by them that it would be easy to work through a Minister who would probably know nothing about the forests and would be glad to follow any advice given to him! In being a consenting party to that transfer he wished to safeguard himself and the Government of Burma very strongly by laying great stress on the fact that the constitution of India provided that at the end of the ten years' period there might be some retracing of steps as well as a further advance. Forests were of such extraordinary importance that if the ten years' experience proved that the experiment of transferring them to the control of the Ministers had not been a success, or at least had been accompanied by a distinct loss or failure, the position might, at the end of that period, be very properly reconsidered. He had no late information as to what the opinion of the Forest Department was at that stage on the practical difficulties of working with Indian Ministers-in-charge, but he had not heard Conservators of Forests and Chief Conservators had found themselves seriously hampered by the circumstances. Forests were not a particularly popular subject, and long views were taken by very few Indian politicians, who were ready to support any demand that appealed at the moment to the popular desire. He had not heard that the step had been in any way fraught with disaster to

the forests, and he hoped if they should be proved to be in danger the position would be again considered. As a member of the Lee Commission he would say that they were not concerned with the question of policy in connection with the matter of the reserved and transferred subjects; the Commission had to take things as they found them, and it was not in their terms of reference. Everyone who had been associated with the Indian Forest Service, as he had for nearly 40 years, would agree that in the maintenance of that service a strong European element was essential for the progress and development of the forests and all that they entailed, both to the people who used theproduce of the forests, the vast agricultural population, and for the development of India's own commercial products, all those things being of the very greatest importance. Professor Stebbing had alluded to the maintenance of a central establishment with an Inspector-General of Forests. If he was called Chief Forest Adviser, or by some other unobjectionable title, the provinces would probably be extremely ready to invite his assistance and co-operation. He had the greatest admiration for the Forestry Department and for the great work they had achieved in India.

Sir Charles Yate, Bt, C.S.I., C.M.G., said he had listened to the remarks of Sir Reginald Craddock with the very greatest interest, because Sir Reginald had rightly estimated the importance of the Indian Forest Department, and everybody desired to see it strengthened in every possible way. Whether, at the end of the ten years, a continuation of the policy of dyarchy and transferred subjects would take place, it was impossible to say at the present moment. He himself hoped that by the end of the ten years there would be a united Government again in India, and the question of transferred subjects would no longer be a vital one. He thought two important points could be gathered from the paper: first, that there was a great shortage of foresters in the subordinate department, and, secondly, a threatened shortage at the very top of the tree. The Indian Forest Department had the finest Research Laboratory in the world, and was one of the finest Forest Services in the world, and he hoped England would learn from the Indian Forest Department and put forestry in this country in a better state than it was at present. He should like to know whether, at the present moment, Indian forestry officers were under the Central Government and under the Secretary of State for India, or solely Provincial Officers, and their terms of enlistment and services in the uncertain state of some other Provincial Officers. Everyone interested should do his best in putting Indian forestry on a permanent basis as was the case with the Indian Civil Service and all the other Services which were of such great importance.

Mr. R. L. Robinson (Forestry Commissioner) said he had listened with

very great pleasure, to the lecture, and that Lord Lovat, who very much regretted being unable to be present that evening, wished to say, on behalf of the Commissioners, how very much those who had to deal with forestry in Great Britain were indebted to the Indian Forest Service for the guidance and inspiration they had given. Although he had no technical knowledge of Indian matters, it was a very great pleasure and duty to follow very closely all matters that appertained to Indian Forestry. He thought the Indian Forest Service was the finest in the English-speaking world. That was due to a number of causes, one being the type of man the Service had been lucky enough to get; and the Service had built up a tradition of faithful and ungrudging service. The third point which had led to the advancement of the Service was undoubtedly the spirit of progressiveness, as illustrated by the recent developments to which Professor Stebbing had referred. If those developments were to be carried on, it was necessary to have really first-class men to do the work. The question was, was the Service getting now, and would it continue to get, the type of man, and give the class of of training which was essential if the Service was going to be anything but a machine?

Professor Stebbing, in reply, pointed out that the title of his paper was recent progress, and, therefore, it had been necessary for him to confine himself to the more recent work, and the remarks that had been made by the speakers would be very useful indeed as an appendix to what he had said in the paper. He had not touched on Education, because that matter was not settled. So far as he was aware the proposals under consideration when he was at Simla last May had not yet received the sanction of the Secretary of State.

With regard to the question put by Sir Charles Yate, he understood that the Service was Imperial, except in the case of Burma and Bombay, where the forests were transferred, and those Governments in future would recruit members for the Senior Services themselves. He was told that where the forests were transferred, the local governments recruited themselves and that that was not liked very much by men who desired to enter the Service; they would rather be recruited by the Secretary of State than by a local government. He had been given to understand that this year the Secretary of State recruited the English recruits and the Local Governments nominated the Indian recruits. One or more Indians had been recruited at home and sent out to India, even up to 1925. Until the courses at Dehra Dun were actually functioning, presumably Indians would still be trained in this country.

The Indian Forest Service would read with pride the remarks made by Sir Reginald Craddock. His knowledge of the work performed by

that Service is well shown in his Minute relating to the Report of the Lee Commission (p. 133). It indicates how truly he appreciates the great value of the forests to India and her people.

On the motion of the Chairman, a vote of thanks was accorded to Professor Stebbing for his interesting paper.—[*Journal of the Royal Society of Arts.*]

RE-ORGANISATION OF THE IMPERIAL INSTITUTE, LONDON.

The provisions of the Imperial Institute Act, 1925 (as summarised in this Bulletin, 1925, 23, 195), in respect of the transfer of the Institute to the control of the Department of Overseas Trade, the appointment of a Board of Governors to conduct its management under the responsible Minister, and the amalgamation with the Institute of the Imperial Mineral Resources Bureau, have been carried into effect as from July 1st, 1925. On that date also the Parliamentary Secretary to the Department of Overseas Trade, as the responsible Minister, appointed Sir Richard Redmayne, K.C.B., the Chairman of the Governors of the Imperial Mineral Resources Bureau, as Director of the Institute temporarily, Sir Richard lending his services for a period not exceeding six months with a view to supervising the amalgamation of the two bodies and to advising upon the re-organisation of the combined institution.

The Board of the Governors of the Institute is composed of the following members :—

President.—Mr. Arthur Michael Samuel, M.P., Parliamentary Secretary to the Department of Overseas Trade.

Vice-President.—*Sir William Clark, K.C.S.I., C.M.G., Comptroller-General, Department of Overseas Trade.

REPRESENTATIVES OF THE DOMINIONS AND INDIA.

The High Commissioner for Canada.—The Hon. Peter Larkin.

The High Commissioner for Australia.—The Rt. Hon. Sir Joseph Cook, G.C.M.G.

The High Commissioner for New Zealand.—* Colonel the Hon. Sir James Allen, K.C.B.

The High Commissioner for South Africa.—Mr. J. S. Smit.

The High Commissioner for Newfoundland.—Captain Victor Gordon.

The High Commissioner for India.—Sir Atul Chatterjee, K.C.I.E.

APPOINTED BY GOVERNMENT DEPARTMENTS.

Treasury.—*Mr. C. L. Stocks.

Board of Trade.—Mr. P. W. L. Ashley, C.B.
Dr. F. H. Hatch, O.B.E., M.I.C.E.

Colonial Office.—The Rt. Hon. Lord Islington, G.C.M.G., D.S.O.
* Sir Gilbert Grindle, K.C.M.G., C.B.
* Mr. P. H. Ezechiel, C.M.G. (Crown Agents).

Ministry of Agriculture and Fisheries.—Sir Daniel Hall, K.C.B., F.R.S.

Department of Scientific and Industrial Research.—Sir Frank Heath, K.C.B.

REPRESENTATIVES OF SCIENTIFIC AND COMMERCIAL INTERESTS.

Royal Society.—Professor J. B. Farmer, M.A., D.Sc., LL.D., F.R.S.

Formerly Governors of the Imperial Mineral Resources Bureau.—Mr. Wallace Thorneycroft, F.R.S.E., M.I.M.E.
Mr. W. Forster Brown, M.I.C.E.
Mr. H. F. Marriott, A.R.S.M., M.I.C.E.

Association of British Chambers of Commerce (*President*).—*Mr. Stanley Machin, J.P.

Federation of British Industries.—Mr. A. Johnston.

Royal Botanic Gardens, Kew (*Director*).—Dr. A. W. Hill, F.R.S., F.L.S.

At its first meeting the Board delegated the detailed supervision of the Institute's administration and finance to a Managing Committee of six members (whose names are indicated by an asterisk) meeting monthly under the Chairmanship of Sir William Clark, and appointed an Advisory Council on Minerals combining the Board of Governors of the late Imperial Mineral Resources Bureau with representatives of the late Advisory Technical Committee on Minerals of the Imperial Institute. Certain vacancies on the Council have still to be filled, but the present membership is as follows :—

Sir Richard Redmayne, K.C.B., M.Sc., M.I.C.E., M.I.M.E., M.I.M.M., F.G.S. (*Chairman*).

The Rt. Hon. Lord Morris, K.C.M.G., K.C. (*Vice-Chairman*).

Dr. J. W. Evans, C.B.E., D.Sc., F.R.S.

Mr. W. Forster Brown, M.I.C.E., M.I.M.E.

Dr. F. H. Hatch, O.B.E., M.I.C.E., M.I.M.M.

Mr. W. S. Robinson.

Mr. W. Thorneycroft, J.P., F.R.S.E., M.I.M.E.

Professor Thomas Turner, M.Sc., F.I.C., A.R.S.M.

Mr. H. F. Marriott, A.R.S.M., M.I.M.M., M.I.C.E.

Sir Herbert Jackson, K.B.E., F.I.C., F.R.S.

Sir Robert Hadfield, Bart., F.R.S.

Admiral Sir Edmond Slade, K.C.I.E., K.C.V.O. (*Vice-Chairman*).

Professor J. W. Gregory, D.Sc., F.R.S.

Dr. C. Camsell.

The Board further appointed a Laboratory Committee consisting of Sir Frank Heath (*Chairman*), Professor J. B. Farmer, Mr. R. W. Matthew, C.M.G. (Department of Overseas Trade), and Mr. Forster Brown, and reconstituted the Advisory Technical Committees of the Institute on Silk Production and on Timbers, the Chairman of which are Sir Frank Warner, K.B.E., and Mr. H. D. Searleswood, F.R.I.B.A., respectively. The operations conducted at the Institute under the direction of the London Committee of the Ceylon Rubber Research Scheme are being continued. The fifteen Advisory Technical Committees of the

late Bureau dealing with different groups of minerals were reconstituted as Committees of the Institute, the members in nearly all cases agreeing to continue their services. An Advisory Council and additional Committees for raw materials of plant and animal origin are in course of formation. The former Committees for the Dominions and India have not been reconstituted, but it has been arranged that the Trade Commissioners for these countries shall have the right of attending meetings of the Advisory Technical Committees.

As a result of a comprehensive Report presented by the Director and adopted by the Board of Governors, the Institute will in future be organised in two main divisions, entitled respectively the Mineral Resources Department, and the Plant and Animal Products Department, each under a Superintendent, and consisting of Intelligence and Laboratory Sections. Distinct from these Departments but serving both alike, will be the Library and Statistical Sections. The Exhibition Galleries will form a unit entirely separate from the two main Departments. A list of the Staff showing the new grouping will be published on completion of the re-organisation and the appointment of a permanent Director.—[*Bulletin of the Imperial Institute.*]

INDIAN TIMBER AGENCY.

Messrs. W. W. Howard Bros. & Co. of London and Southampton, desire to make known the fact that they have resigned the position which they have held since 1916 as agents for the sale of timbers for the Government of India, the Government of Burma and Provincial Governments.

It is with the greatest reluctance that the firm have found themselves obliged to take this step, which has been solely occasioned by the terms of the agencies being not sufficiently attractive under present circumstances.

Although the situation was clearly represented to the Government more than two years ago, no improvements of the conditions of the agencies have been proposed.

The agencies will terminate on June 30th, 1926, and Messrs. W. W. Howard Bros. & Co., desire to make it known that the balance of the Government stocks on hand are for sale, and that they will continue to make contracts until the date above-mentioned.—[*The Timber News.*]

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FORESTRY IN QUEENSLAND.

The area of Queensland is about 430,000,000 acres and the Forest Department has obtained control of 1·14 per cent. of that area, or 4,876,000 acres, having added 113,000 acres to their estate during the year 1924. It is interesting to note that since 1900 the area of forest reserves in Queensland has fluctuated a great deal and that, between 1905 and 1907, and again between 1913 and 1919, the areas under the Forest Department were steadily decreasing. Since 1920, however, a change for the better has set in, and the total is increasing year by year, so that it is reasonable to hope that the Hobart Forestry Conference estimate of 6,000,000 acres of permanent forest for Queensland may be attained. Queensland occupies the north-eastern part of Australia, and its northern promontory comes within eleven degrees of the equator, so that a considerable portion of the province enjoys a tropical climate.

In the annual report of the Forestry Board for 1924 it is remarked that the beginnings of forestry in Queensland were feudal and that the people have for long had the same antipathy to forests as those who lived under William Rufus and were forbidden to interfere with that King's sport. During the last seven years, however, the Forest Department has endeavoured to put forestry in the province on a business footing and to shift its basis "from the traditional to the economic," proceeding with this purpose in view with proper methods of valuation, demarcation, survey, milling and so on. The administrative authority

is now a Provisional Forestry Board of three who operate through three main branches, Utilisation, Administration, and Forestry proper (silviculture, working plans and surveying). They look ahead in Queensland and calculate that if the present population, 810,000, is using about 250 million superficial feet of timber per annum, the population 100 years hence, which will probably amount to 10,000,000, will need 2,500 million superficial feet which is forty times the amount now obtained from the forests under the Forest Department. The surplus has increased from £11,000 in 1904 to £206,000 in 1924.

Among the native flora two of the most important species appear to be *Araucaria Cunninghamii* (the Hoop Pine) and *Araucaria Bidwilli* (the Bunya Pine). The Hoop Pine attains a height of 150 feet and a diameter of five feet on the Richmond River in New South Wales and is said to be abundant in Queensland from the Macpherson Range in the south to Gladstone, also in the Ipswich, Toowoomba, Warwick, Nanango, Mackay and Bowen districts. It is an important cheap softwood, taking the place of deal in Europe.

The Bunya Pine occurs principally in a narrow belt between Gympie and the Bunya Mountains, ascending almost to 3,500 feet and prefers an average rainfall of more than 30 inches. It is a large tree with a bole of 80 feet at times, and a diameter attaining six feet. It does not grow pure, but usually with Hoop Pine and rarely forms a large proportion of the growing stock. The seed is very fertile when fresh and does not retain its power of germination long. The timber is cut and sold with that of Hoop Pine but is said to be better for staves and for boat-building.

Mr. E. H. F. Swain, Chairman, Provisional Forestry Board, writes in the Australian Forestry Journal for March 1925 :—

"Queensland is fortunate among the Australian States in possessing some home supplies in softwoods. There was a time, in fact, when Queensland had a surplus for export. But of Queensland's original four billion feet of standing pine, three billion have already been turned into houses, and, at the present rate of consumption of 98 super feet per capita per annum, with a two per cent. increase in population to be expected, only ten or

fifteen years' life remains to the pine sawmilling industry of the State.

"The rotary plywood trade of Queensland, established only a few years, has only a few years to live so far as pine and maple logs are concerned; and these will both have gone the way of red cedar by the year 1935.

"By dint of rationing, by dint of dilution with hardwoods, by the greater utilisation of the at present despised secondary woods, and by resort to increasing importations from the United States of America, Canada, and the Baltic, Queensland will probably be able to carry on for the next thirty years, with, however, a continually declining consumption and a continuous increase in price."

"There are in Queensland four million acres of land reserved for forestry purposes. Much of it is mountain range and sand, barren of little value either for agricultural or silvicultural settlement. A little of it is good forest plantation soil, much desired by the private farmer. The natural vegetation of our jungles is a medley, a mixture of prime species in a wilderness of many trees; a scant commercial stand, congested, and showing little growth, extraordinarily deficient in the junior age-classes, a forest at sight of which Lord Novar exclaimed: 'A silvicultural slum.'"

"But Queensland cannot wait. Her case brooks no delay, and she must take silvical risk. In 25 years from now, we will have no softwoods save what we can import, and what we may grow within that time. In Europe it takes 120 years to grow 60,000 superficial feet of timber per acre, and two centuries is allowed for the production of an oak crop. The fundamental difference between agriculture and silviculture, after all, is one merely of the time element in crop production; but to sow a field in the full realisation that two hundred years must elapse before harvest time, requires a more spacious faith, and a higher courage than are called for, ordinarily, in rural pursuits. This faith, and this courage, the forester possesses, and he is willing to apply to his investment the acid test of the compound interest table to

prove that forestry yields at least as high a dividend as does agriculture."

"There are amiable folk whose enthusiasm for forestry would push us into the deserts and barrens where nothing might grow except trees, and these but slowly and unprofitably. There are people who would urge us to plant larch and fir and oregon and British oak in Queensland, not knowing the law of the forest which gives to some species the summer rainlands and to others the winter rain regions. But the forester must not be stampeded into planting panics nor depart from his patient building up of new forests, having both financial stability and bio-physical balance.

"There are, however, in Florida, in India, and in the Philippines, in similar climates to our own, trees which on similar soils might be introduced usefully, to supplement our own native stores. Such trees have been observed by Queensland Forest Service officers in their natural haunts and are now being grown here experimentally. Already the Chir pine of the Himalayas may be seen flourishing in Brisbane Gardens, whilst in the Rockhampton Botanical Gardens is thriving the cypress tree of the knee-deep cypress swamps of Florida, this time upon a sunny hillside. The important Caribbean and Loblolly pines of the sandy loam wet plains of the south-eastern United States of America should grow equally well upon the better quality sites of the Beerwah-Beerburrum lands, and the Benguet pine of the Philippines should succeed wherever Hoop pine thrives. These trees and others the forester may call to his aid in Queensland to supply the needs of the sawmills of sixty years hence with 48-inch logs. For larger logs the sawmills henceforth may whistle. It will not pay to grow them, and we cannot wait. Wide boards will become antiquities, and rotary veneering of massive logs will give way to other arts of the forest products engineer and wood craftsman."

"But Queensland can produce several other precocious young prodigies of the tree world. On Fraser Island, a handful of blackbutt seeds became a forest of trees 80 feet high and 3 feet girth within the space of six years, whilst spotted gum and flood-

ed gum give indication of being able to excel even this phenomenal increment. The softwood species, however, are our most urgent concern at this stage, and the Forest Service has been gathering together data respecting several of our indigenous woods which have exhibited remarkable growth activity. Such are southern silky oak, and quandong, and cypress pine which, planted now, are expected to be fit for milling against the timber crisis of the year 1950, 25 years hence, and 35 years before the new forests of Hoop and Bunya and Kauri pine are scheduled to be logged."

So that Queensland is faced with the urgent necessity of making plantations and may have to spend £100,000 per annum on the work.

In the October number of the *Australian Forestry Journal* Mr. Nixon writes on Queensland's position and Mr. Grenning's Bulletin on "The Softwood Problem in Queensland" is discussed. The interesting Hoop Pine is thus referred to—"The hoop pine forests are very much under-stocked, and generally a great deficiency of the younger-age classes obtains. The increment put on by the mature trees is very small, and is probably more than balanced by the decay of the over-mature. From an economic point of view the mature trees should be removed as soon as possible. The increment of the under-mature pine will not supply more than a small part of the annual requirements of the State.

"The species is very difficult to regenerate; it is a light-demander, but will endure a limited amount of shade. It regenerates on the edges of the jungle, where competition with other species is not intense. As the trees develop the jungle advances, consequently the edge of the jungle may be many chains distant when the tree reaches maturity. Though the seed will germinate under heavy shade the young seedling soon dies; light is very essential. Since the species is very sensitive to fire, the possibility of much regeneration on the edges of the jungle is greatly restricted."

In the November number of the same Journal Mr. C. Lane-Poole's report on the subject of the proposed Federal forest

policy is printed. He has the same story—the urgent necessity of measures to preserve the remaining forests and form new plantations.

"It will be asked how it is that with a population of a little under six millions the country is unable to provide its own timber requirements from an area of 24,500,000 acres, which should obviously be yielding over 12,000,000,000 super feet per annum. Why are we importing 364,500,000 super? I have already partially answered these questions and have stated that on the one hand our hardwood forests are not adequate and our demand is for softwoods which we must import. The inadequacy of our hardwood forests is due to the gross overcutting that has taken place in the past and to the very paltry efforts that the States have made to restore their forests and so manage them as to get a maximum yield per acre. Instead of 12,000,000,000 super feet our forests are producing 587,500,000 million super feet.

"Looking now at the forestry side of the Australian timber situation what is the condition of our forest heritage of 24,500,000 acres? This relatively speaking small area of land is carrying to-day remnants of virgin forests, but is mainly covered with a bad growth of uneven aged timber which has grown up more or less haphazard after the sawmillers have picked the best out. The areas are swept by fire for the most part, and instead of putting on a satisfactory increment annually are standing still, *viz.*, their increment is cancelled by the loss through fire and other causes. These forests are dying as fast as they are growing, and a minimum of timber is standing on a maximum area of land. But this is not all, for the land on which the forests are growing is not dedicated to forestry."

He states that Queensland has one fully trained forest officer.

A good deal of comfort may be obtained from the Queensland Annual Report for 1924, as plantation work seems to be conducted on a large scale by good methods. Excellent photographs are given of a Hoop Pine plantation nine years old, of well cared-for forest nurseries, and of a wood, aged four years, of Grevillea (called silver oak in India) of astonishing growth.

The stock in the nurseries, at the close of the year will make it possible to plant up 1,400 acres in 1926, which will be the first year of considerable planting operations.

Wood Technology appears to have received a good deal of attention, a matter indicating progress on sound lines. A Universal Wood Index system is referred to and it would be of great interest if particulars of this were made available for other forest officers. As a result of Wood Technology a demand has been created for timbers hitherto neglected and many most useful articles have been made experimentally from Queensland woods.

Minor Products have not been neglected and notes are given on several good oils. As was to be expected Eucalyptus is important in this way, and *Backhousia*, *Leptospermum*, *Homoranthus*, *Eugenia*, *Zieria* and *Boronia* also appear promising.

Prickly pear and lantana, foreign pests, have received due attention. A species of Fomes is noted as damaging Hoop Pine.

The Queensland Forest Service is evidently determined to make a good start and is to be congratulated.

A. R.

IMPRESSIONS OF A CASUAL VISIT TO THE GOVERNMENT TIMBER DEPOT, AHLONE.

The impressions of a Forest Officer who now and again wanders into the Government Timber Depôt in Rangoon just to see what is going on—an officer who has no connection with the Depôt and who specialises in nothing—may possibly interest those who have never been there.

To anyone who knew the Depôt some years ago, a low-lying muddy, mangrove swamp, solely concerned with the receipt and disposal of Government Timber and a spot where no outsider dreamed of going except for the purposes of examining and buying timber, the present Depôt is unrecognisable. The land has, in recent years, been reclaimed by the Rangoon Development Trust, the whole area having been raised several feet by the deposit of a firm layer of sand, entirely transforming the land-

scape and enabling the Depôt to be reduced to an area of some 40 acres. It occupies an open breezy spot with a frontage along the river. The buildings are scattered among large open spaces of sand and coarse grass. It is now-a-days in the evenings a play-ground for European children from the neighbourhood and (a fact which supports my recommendations) it is even used as a lovers' walk, alternately to gaze into the sunset across the river and to gaze into each other's eyes behind the kiln.

2. As one enters and proceeds up to the centre buildings a superficial glance gives the impression of a comparative absence of timber. When you enter a timber depôt you normally expect to see a mass of timber. And so you do if you proceed a little further to the banks of the three sale-ponds, the brilliant conception of Mr. Leete, where, hidden from distant eyes, is collected all the Government teak timber extracted from the Myitmaka Extraction Division. The ponds are 8, 8, and 10 acres in area respectively, parallel to each other, and close to the river, each capable of containing 5,000 to 6,000 logs. The logs are floated in from the river at high tide through sluice gates and at low tide they can, when necessary, be exposed on the mud for inspection. Here the monthly teak auctions are held.

3. Another reason which helps to convey the original impression, on entering, that there is a dearth of timber about, is that the Depôt is inaptly called a Timber Depôt. It is in reality a Research and Timber Depôt and here we have the nucleus of the Economic Branch of the Forest Research Institute of Burma.

I do not propose to discourse on any technical details of the research work; they are the province of the officers in charge of them and anyhow I am quite incapable of doing so.

After passing under the gantry which feeds the mill, I will, however, take you to the show-room. Here the visitor will meet the Forest Engineer in charge and will be amazed when he views the furniture exhibits. An instinctive dart is made towards a truly wonderful little round polished table made of *sandawa* (*Cordia fragrantissima*) and another dart, with a rising thirst,

towards a highly refined folding liquor cabinet, known as a "secret vice." Elsewhere are almirahs, folding-top-desks, bedsteads and dressing-tables made in the workshops of Burma hardwoods, such as mahogany, laurel-wood and many others. The articles on display are so chaste and refined that one could fondle them like a newly purchased limousine (especially the secret vice). All thoughts of Chippendale and Sheraton in our retired home vanish and we determine at once to lay in a stock of Depôt furniture, as many have done and are doing. We get rather a shock when we first become aware of the prices, but the value is all there. In one corner I spot a dozen laurel-wood pipe ash-trays with knockers in the centre. These were sent out as Xmas presents to administrative officers and to persons interested in the trade. The fate of one of them was to be immediately appropriated (with permission) by the retiring head of a European timber firm. What commercial instinct to be sure! This ash-tray will probably repose in the hall of a Scottish mansion, it may even be presented to a London Club and will be the talk of the smoking room. We are at last learning to advertise, but surely the commercial instinct would have been still further developed if they had given *me* also an ash-tray; but I must wait till I am an administrative officer—for this alone will I endeavour to avoid being passed over!

4. In this manner the Department is endeavouring to prove to the world the value of its hardwoods for furniture making and indeed for numerous other purposes. For instance, requiring a hollow spinnaker-boom $1\frac{1}{2}$ inches diameter for a racing sailing boat on the lakes, the Depôt turned me out one of 3-piece kiln-dried lengths of *Heretiera Fomes*. The fact that, unfortunately it started gaping merely disclosed that the fibres of this timber will not stand up to this particular treatment.

To see where the furniture and other things are made, a short step across to the wood-workshops is necessary. This is a new building some 200 feet long Entering at one end (if one is able to see past the massive form of Mr. Cogger, the Officer-in-charge) there appears to be in operation every wood-working machine that has ever been advertised. Nearly all the workmen are Chinese

and under able direction the results must make the local Chinese furniture-carpenter dumbfounded. There is under construction here a 24 feet long laurel-wood table for a local Trust Board, designed so that no one is interfered with by the under-structure at any position. The corresponding thought has necessarily to enter my mind that there are great facilities for falling under it.

5. A few steps from the workshops is the battery of three Tiemann kilns, the other side of which, as I mentioned before, is considered a romantic spot. These kilns are essentially for experimental purposes and the first impression gained is that if a larger number of polished controls, dials and gauges have ever been collected together on a similar circumscribed area, it can only be at the Central Electric Control of the latest model battleship. Humidity and temperature can here be controlled to the smallest fraction and a number of most interesting experiments, among them a series of recovery tests are now in course of operation about which we shall no doubt hear from the proper source in due course. It is proposed to install shortly a Sturtevant kiln which is expected to be more suitable in the Rangoon climate.

Circling round and leaving the sale-ponds on the left, a walk of 150 yards or so leads to the Seasoning Shed where a small stock of air-dried converted timber of numerous kinds is kept for supply to enquirers, and where data as to air-seasoning are obtained. This shed has Venetian walls to regulate the air circulation as required.

Circling further and not far from the Depôt gates, the saw-mill is reached. This is a small up-to-date saw-mill by Ransome, driven by an electric motor of 100 horse-power, which derives its current from the main Rangoon supply. There are installed two rack-benches with circular saws, two cross-cut swing saws and a sharpening machine are still awaiting installation. The purpose of this mill is solely to convert timber for the Depôt and there is no more up-to-date mill in Rangoon.

6. Such is a cursory early morning survey of the Depôt, the detailed research activities of which are numerous.

A casual visit emphasizes the wonderful optimism of the Department. We have at present practically no markets for our

hardwoods except *pyinkado* and yet we are convinced the time will fructify the present policy of research and advertisement.

A. B. N.

REVIEWS.

PINUS INSIGNIS, *Doug.* (*Pinus Radiata. D. Don.*) IN SOUTH AFRICA.

By N. L. King, District Forest Officer, Tokai, Cape Province.

Bulletin No. 15 of the Forest Department, Union of South Africa.

The genus Pinus forms the greater bulk of the economically important Indian coniferous forests. There are five species of pines in the Indian region, three of which are the Himalayan, *viz.* *Pinus excelsa*, *Pinus longifolia* and *Pinus Gerardiana*, one, *Pinus Khasya* occurs in Assam and parts of Burma, and one, *Pinus Merkusii*, which is essentially a tropical pine, is found in Burma. The Indian pines, with the possible exception of *Pinus Gerardiana*, which is more known for its edible seed, are of very great commercial and silvicultural importance. They have a high potential value as producers of resin and timber.

Certain exotic pines have been occasionally planted in India on a small scale. *Pinus Pinaster* and *Pinus sylvestris* have been grown in the Himalayas. The former is said to have done moderately well in some localities, but the latter has failed Small plantations of *Pinus Pinaster* and *Pinus insignis* have also been formed in the Nilgiris but neither of them are reported to flourish there.

The bulletin gives a very interesting account of the silviculture of *Pinus insignis*, commonly known as the Monterey Pine or the Remarkable Pine, which has been successfully introduced and extensively planted during the last 40—50 years in South Africa, New Zealand and Australia. The native home of *Pinus insignis* is the Monterey Peninsula (United States of America) and the following statement by Wilson (Northern Trees in Southern Lands, E. H. Wilson) quoted in the bulletin is indeed a striking commentry on the successful introduction of this pine into the above lands :—

" Altogether, so far as the evidence goes, it rather looks as if this pine will prove the North's greatest gift to the new forests in those parts of the world. It will surprise others no doubt as it did me to find a species of so little value in its native land to be of such immense importance in the Antipodes." Most of the silvicultural statements made regarding the Monterey Pine might be equally applied to other species and therefore Indian Forest Officers in general and those who are interested in the introduction of exotics in India in particular, will find the study of this bulletin, which is well illustrated with photographs, very interesting.

The striking features of *Pinus insignis* are its extremely rapid growth and the high returns, both in volume and value, in a comparatively short period. The timber is useful for a variety of purposes. It is light, strong and tough, holding nails excellently and so it is well adapted for use in the box wood and crate industries. " The wood has also been pronounced quite suitable for match boxes and match sticks. The laboratory experiments in the United States of America indicate that the wood is easily pulped by the sulphite process and gives a high yield, the pulp being of good colour and fair strength, though difficult to bleach " (Austr. For. Journ., May 1922). This pine is already a valuable asset to the countries in which it has been grown and it is possible that its cultivation in suitable localities in India which have no other valuable soft and light timbers, will, under proper management, be a sound economic proposition. The afforestation of barren waste lands, of which there are not few in India, with some rapidly growing and economically important species, has always been a problem, and it is hoped that this pine will be given a fair trial in localities suitable for its cultivation. If successful, it is sure to transform in a comparatively short period at least some of these eye-sores into prosperous revenue yielding territories.

The main facts concerning the silviculture of *Pinus insignis*, its growth and yield, and the financial considerations of the proposition, so admirably described in the bulletin, are summarised below :—

The climatic conditions prevailing in the Monterey Peninsula, the natural habitat of *Pinus insignis*, are "Winter rainfall, daily fogs during summer and an extremely mild and equable temperature." The average annual rainfall is 18·13" and the average maximum and minimum temperatures 61·9° F. and 50·2° F. respectively. "In its native habitat this pine is essentially a coastal species and it fails in the hot dry interior of California." The soil varies from an almost pure sand to a fine sandy loam. In its adopted homes, however, the species stands a much heavier rainfall, 21"—35" per annum and sometimes even more, chiefly summer (New Zealand and South Australia) and a much wider range of temperature, 0° F. to 70°—80° F. (New Zealand). A permeable soil suits this tree (New Zealand) and it is said to grow well "in pure littoral sand country and best on fairly deep and moderately strong clay loam, overlying a permeable clay" (Australia). In South Africa there are some good stands of this pine at an elevation of 3,753 ft. with rainfall of about 50", but the most suitable area for the cultivation of this pine in the Union is the coastal belt of the South-Western and Southern districts of the Cape Province, the climate of which is characterised by a winter rainfall and more equable temperature than in the other parts of the Union. The tree requires for its best development "a moderately fertile, well-drained, and deep soil, which is free from lime." The situations on the foot of hills and lower slopes of mountains are specially suited to its growth. And in a sub-continent like India with varied climates and soils, localities can surely be found which are eminently suitable for the cultivation of this tree.

Pinus insignis begins to seed at an early age, and fertile seeds have been collected from a 7 year old tree. The seeds are small and winged, 100 lbs. of fresh cones yielding from 1·6 to 1·9 lbs. of cleaned seed, 1 lb. containing 15,000 to 17,000 seeds. "As a rule not more than 50 per cent. of the seeds are fertile" but the New Zealand State Forest Service guarantee a germination of 80—85 per cent. and seed can be purchased from the Director, State Forest Service, Wellington, New Zealand.

The artificial regeneration of *Pinus insignis* is said to be easy. Planting is preferred to direct sowing and for this purpose seedlings are raised in seed beds or preferably in half paraffin tins. These are pricked out into transplant trays, about 25 plants to each tray, and when the plants are a year old, they are planted out in the prepared ground after the break of the rains in July or in the ensuing autumn, the time of planting depending upon the local climatic conditions. $6' \times 6'$ planting is considered most suitable but this may be increased to $8' \times 8'$ or $9' \times 9'$ according to requirements.

Direct sowing in "spots" at desired distances, putting 8—10 seeds in each 'spot,' is recommended "only in virgin soils where natural vegetation and weeds are not aggressive," 1 lb. of seed being sufficient for 1 to 2 acres according to espacement. The spots are 'staked.' One weeding and hoeing when plants are 1½ to 2 years old is considered sufficient. Blanks are filled up not later than the following season, good strong plants being used for this purpose in preference to seed. Absolute clean cultivation by means of ploughing or hand-picking is very strongly recommended. "To pick merely the spots to be planted or sown is false economy and generally leads to failure." "In South Western districts of the Cape Province the first ploughing is effected in the spring and the ground is allowed to lie fallow until the autumn, when it is cross-ploughed and harrowed. This preparation, it is believed, destroys the natural vegetation, sweetens the soil, and gives it a good tilth."

Heavy and regular thinnings commencing at an early age are considered essential, and a suggested density of stocking at various ages based on a study of various stands at Tokai plantations is indicated in a table: starting with 550 trees per acre ($6' \times 6'$ planting) at the age of ten, 320 trees are left at 15, 200 at 20 and 130 at 25. This is the final crop and no more thinnings are carried out even for longer rotations. The first thinnings in a stand are, as a rule, not carried out "until the weeds and undergrowth have been suppressed and the lower branches have begun to die."

Pinus insignis does not readily shed its dead branches even in closely grown crops, and in order to obtain clear timber, the

author advocates pruning not only the dead branches but even some of the living ones, close to the stem, with a saw, sharp hatchet or axe, during the winter months. And in support of this practice of pruning, he quotes eminent authorities like Hartig, Schlich and Hawley.

"When planted in suitable localities *Pinus insignis* is not very susceptible to disease." It is, however, liable to various fungi, insects, fire and climatic dangers like drought, hail and snow. It is very sensitive to injury from fire, particularly during the first 10—15 years of its life. Except *Diplodea pinea*, most of the disease-causing fungi to which this pine is liable to infect the plant in the seedling stage. "Damping off" is common in the nurseries, especially in the summer rainfall areas, and the best remedy is "the adoption of autumn nursery sowings." *Pestalozzia* and *Fusarium* spp. have been found to infect the transplants : *Pestalozzia Hartigii* "destroys the cortical tissue just above the ground level resulting in the death of the plants" and a *Fusarium* species causes "Wilting disease." *Hysterium pinastri* attacks "the leading shoots of the trees and causes them to die back from the top." *Diplodea pinea* and *Pestalozzia funerea* attack "both the leading shoots and terminal shoots of side branches" the danger of the disease being much greater in the regions of heavy summer rainfall.

Various insects are recorded to attack this pine but the damage from insects attack has not so far been of a serious nature.

Indian Forest Officers are generally familiar with the phenomenon of "Yellowing" in nursery practice. The nursery seedlings "often turn sickly yellow, the plants appear to make no progress and some of them even die." This, the author says, is probably due to the deficiency of soil or the acidity of soil and the addition of 1 oz. of Square Brand fertilizer to each nursery tray or a liberal dressing of liquid manure restores healthy colour and normal growth to the plants.

The growth and yield figures of *Pinus insignis* are very interesting. The tree attains magnificent sizes at a comparatively short age. In its native habitat, the pine grows to an

average height of 80′—100′ and an average diameter of 20″—36″ but in New Zealand it attains a height of 80′—150′ with an average diameter breast height of 30″—36″. In South Australia, one tree in a favourable locality with a 30″ rainfall is recorded to have attained a height of 110′ and a diameter breast height of 53″ in 60 years, while another tree 27 years old measured 36″ in diameter at butt end. In a 1918 sale at Tokai the largest tree measured was 35 years old, 136′ high and 38·2″ diameter breast height with a volume overbark of 315 c.ft. A tree in Madras measured 32′ high and 27′ girth at the age of 8 years.

The rate of growth is of course not very high for the first 2—3 years, but after this the tree grows with extraordinary rapidity, the height growth culminating at about the 12th to 15th years when it gradually slows down, although still continuing fairly rapid until the 24th or 25th year after which no further great increase in height occurs. "As showing the extremely rapid growth in youth which can be made by this species Mr. Owen Jones records a specimen in a 5 years old plantation at Bright, Victoria, with a height of 30′, nearly 20′ of which was put on during the 5th year." (Austr. For. Journ., May 1922).

In New Zealand *Pinus insignis* measured in the State plantations, 22 years old, showed an average annual height growth of 4′ with diameter increase of 2″ annually in the early period.

The returns per acre are excellent. "In Bundaber forest, South Australia, with an annual rainfall of about 21″ the stand per acre amounted to 6,000 c.ft. at 26 years, stem timber down to 4″ being measured. At Mt. McIntyre, with a higher rainfall and a cooler climate, a yield per acre of 8,400 c.ft. in 30 years is recorded. At Narara, New South Wales, with a sub-tropical climate and annual rainfall of 50″, conditions not most favourable to *Pinus insignis*, a 12 year old crop averaged 2,000 c.ft. per acre," (Austr. For. Journ., May 1922). A plantation felled at 46 years of age produced 13,021 c.ft. per acre, *i.e.*, an average annual increment of 283 c.ft. and stands which have given a mean annual increment of from 245 to 254 c.ft. per acre are not uncommon in Australia. The yield obtained from an 18 year old plantation

was 4,307 c.ft. per acre. In South Africa, a 25 year old crop yielded 10,400 c.ft. per acre, the mean diameter of the crop at 4½′ being 16″ and mean height 85′. This is sufficient to show what a high and early return of merchantable timber this pine is capable of yielding, and the average annual increment figures are not less striking!

In the concluding chapter of the bulletin, estimates of the cost of creation and upkeep of *Pinus insignis* plantations and of the returns which may reasonably be expected from them are given in a lucid manner. The expenses are based on labour for the preparation of soil, etc., valued at 3*s*. 6*d*. per diem.

To grow a plantation of *Pinus insignis*, spaced 6′ × 6′, on a 35—40 year rotation, is estimated to cost 460 shillings per acre excluding the administration and protection charges which the author estimates at 7*s*. 6*d*. per annum per acre. A 9′ × 9′ plantation grown on 20 year rotation is calculated to cost only 310 shillings per acre, excluding the cost of administration and protection. This is a very liberal estimate of the cost of formation and a considerable reduction in the cost can be brought about by proper supervision and careful management. The receipts have similarly been calculated, a conservative value being put on the volume returns, both from thinnings and the final crop. The total receipts for 6′ × 6′ plantation with 40 years rotation are estimated at 8,450 shillings per acre and those for 9′ × 9′ on 20 years rotation at 2,370 shillings. This gives a net return of 7,690 and 1,910 shillings per acre respectively. The compound interest calculations have not been made.

The figures of 1918 sale of *Pinus insignis* timber from Tokai plantation are of very great interest. "Trees 32 to 35 years old, standing on an area of 163·4 acres were sold. The timber was put up to tender and disposed of at prices ranging from 1*s*. 6*d*. to 2*s*. 3*d*. per c.ft." The purchasers "had to fell the trees and pay for all wood over 4″ in diameter exclusive of bark." The total yield was 734,450 c.ft., which realised £64,905 1*s*. 6*d*. or £397 4*s*. 4*d*. per acre. The sale was, no doubt, made at a very favourable time "when prices ruled high, but nevertheless

the figures give a good indication of the possibilities of raising *Pinus insignis* in favourable localities" and this may equally apply to India.

PARMA NAND SURI.

CAUSES AND EFFECTS OF WINDFALL IN FORESTS.

Pulp and Paper Magazine of Canada, January 21st, 1926.

Windfall in Canadian forests is traceable to three distinct causes : whirlwinds of small magnitude, strong winds following sleet storms which have left the trees heavily laden with ice, and winds in areas co-operating with heavy fungus attack. The first is economically unimportant, the second is but occasionally extensive, but it is the third cause that is responsible for the enormous number of windfalls and wind-breaks so extensive in Eastern Canada.

The fungi responsible for this widespread damage are *Stereum Sanguinolentum* and *Poria subacida,* the former and more important one causing 'red-heart rot,' and the latter 'feather rot' in balsam fir.

The fungus *Stereum sanguinolentum* was originally a pure saprophyte, attacking only dead balsam fir, but it has now developed into the most dangerous parasite that ravages the Canadian forests. Spores infect trees through wounds, frost cracks, injured tops and dead branches in the lower part of the crown, the decay spreads very rapidly in a vertical direction involving, almost at once, most of the heartwood, the cambium and the bark are next attacked, and the tree dies. The decay continues in the dead tree so that a badly infested area presents standing dead trees, broken off stumps of all heights, fallen trunks and slash—all centres of infection.

Why did this fungus, originally a harmless saprophyte not much in evidence, develop in recent times into a devastating

parasite? In the old days the Canadian forests were a mixed stand of spruce, pine and balsam fir, a mixture which Nature found eminently suited to the locality. Spruce and Pine only were in demand until recently, so that lumbering was confined to these species, which has thus resulted in converting a mixed forest into a more or less pure stand of balsam fir. The condition thus created favoured the spread of this fungus, which is confined to balsam fir.

It is also responsible for the budworm attacks on balsam fir that have recently been decimating these forests, leaving a vast number of dead trees and fallen trunks, on which the fungus thrives and spreads with increasing vigor.

In there, then, no escape from this vicious circle of budworm and fungus? If the next generation could be expected to be a mixed stand, hopes might be entertained that the fungi and the insect-attacks would cease by themselves; but a close examination of the forests soon dispels such hopes!

Beneath the ground-cover may be noticed everywhere masses of suppressed and retarded growth of coniferous trees, ascertained to be thirty to forty years old, and eager to grow up and form the next generation at the first magic kiss of light from above. Where the canopy has recently been opened by budworm attacks this suppressed advance growth is shooting up rapidly in masses of densely packed poles. Since this sleeping generation, now waking up to new life, is composed of nearly pure balsam fir, the future crop on these areas will be pure stands of this species and is, therefore, foredoomed to be totally annihilated by the budworm and the two fungi!

The only way out appears to be "forest sanitation." Since the fungus is known to attack slash first and to form on the slash sporophores for further dissemination, all slash must be thoroughly burnt. Next, all trees attacked by budworms should be cut. The next step should be the creation of a healthy future generation by thinning out in the young balsam stands, as suppressed slow growing trees have small resisting power.

But the most important step is devising means for stopping the budworm attacks. The solution appears to lie in the para-

sites, mainly fungi, of the moth of the budworm. Urgent further research in Forest Entomology and Pathology is strongly indicated.

T. V. VENKATESWARA AYYAR.

JOURNAL OF FORESTRY, JANUARY 1926.

The Society of American Foresters have provided some very interesting reading in their January publication. The translation from Prof. Gustaf Lunberg of Stockholm on " The Drainage of Swamp Lands for Forestry Purposes " deals in a very practical manner with the methods employed in Sweden for the reclamation of these areas. Of course the value of forests in Sweden make this work possible from an economic standpoint ; it will be some years to come before India can take on and treat in a similar manner her "Tappars" and " Chandars" (various types of grassy blanks) so frequent in the forests of the North.

The statistics for the past 40 years show the increase in the amount spent on this work by the State. In 1875—1880 the average annual expenditure was $1,240·00 and for the years 1915—1920 $ 115,825·00. The above only refers to 15·8 per cent of the forests. The remainder is privately owned, and although the paragraphs on the work in these forests deals with less than half of the remaining 85 per cent., it is plain to see that private owners have taken this work very seriously, and find it a profitable undertaking provided suitable land is chosen.

The author deals with the question of side slope in the drains and shows how with careful judgment there can be a great saving in the quantity of earth work. It is interesting to note that, in undecayed sphagnum peat, vertical walled ditches resist frost deformation better than those with sloped sides. The best results are obtained by cutting through the peat to the mineral soil, but this is not always possible as it becomes a matter of cost, and various methods have been devised for getting over this difficulty. The economic limit for drainage

is from 4 to 12 men days per acre. (The cost of labour is not stated but is reckoned on an 8-hour day.)

Provided, of course, seed trees are near, these drained areas fill up naturally very quickly, and what is more with a desirable species, in any case birch comes in first, and spruce under it, and by thinning out the birch a pure stand of spruce is obtained. They can always depend on the drained areas producing natural birch, but it pays to introduce pine artificially as soon as possible ; this species is preferable to spruce because the latter is susceptible to the summer frosts Emphasis is laid on the necessity of frequent thinnings in the drained areas, which of course induces the production of large crowns, and it is pointed out how necessary it is to increase transpiration, and so keep up an ever-increasing consumption of water. One method of stocking with pine is by sowing on the snow at the end of the winter. This is quite understandable, but the sentence which follows rather puzzles us,—"Often, in order to reduce the cost seed of low germinating capacity, which has been sorted out of good seed, is used." We can only suppose that seed is very costly, and germination being so easy the young trees are not required to come up thick on the ground. Artificial restocking of swamps can be done only after a period of years, *i.e.* when drainage has had its effect on the swamp flora, etc., yet on the other hand planting on "converted peat" is often successful immediately after the operations.

In conclusion we quote the auther :—

"Failures serve as a warning, that certain judgment is required in deciding what types of swamp land should be drained for forest purposes, but in no way challenge the importance of drainage work as one of the most effective methods of increasing Sweden's forest production."

There are two or three other articles but the one of greatest interest is "The importance of seed source and the possibilities of Forest tree breeding" by Jacob Roeser Jr., Assistant Silviculturist, Rocky Mountain Forest Experimenting Station. Work on these lines is only in its infancy, and as the author points out, a great deal can be done by a careful study of the crop, and by only reserving

those trees for seed, which show the best characters. Recently articles on this subject have appeared in the *Indian Forester* and we feel sure that a study of this article will repay all those who are interested in this very important branch of Forest Science.

C. T. T.

THE FAMILIES OF FLOWERING PLANTS, DICOTYLEDONS.

By J. Hutchinson, F.L.S., Macmillan and Co., London, pages IX + 328 with 264 illustrations, 1 diagram and 29 distribution maps. Price 20 shilling.

Foresters and others in India are better provided with help and conveniences nowadays than in the early years of my service. This applies emphatically to botanical research now that there are quite a number of local floras. I can well recollect the feeling approaching despair that possessed me when attempting unsuccessfully to identify some of the plants I came across, more particularly one over which I spent several hours in the aggregate only to discover on referring to the Sibpur Herbarium that it was an American plant (Turnera) and did not appear (nor even its family) in the only flora I had access to—the Flora of British India. It was then a question of pegging away and by a process of elimination arriving at the family after much labour, there being no key to the families in the work mentioned ; a not entirely unprofitable exercise but rather a waste of time when there was so much to do. Prompted by these recollections, I wish to bring to the notice of foresters, whether practised in botany or not, a new work which would have been a godsend to me in those far off days and that even now is of great assistance. I refer to a book that has just been published by Messrs. Macmillan & Co., entitled "The Families of Flowering Plants," by Mr. J. Hutchinson, F.L.S., Assistant at the Herbarium, Royal Botanic Gardens, Kew. Mr. Hutchinson needs no introduction to botanists of experience but as it is more especially the beginner I desire to interest I would add that the author has an established reputation as an expert in systematic botany, having assisted in the preparation

of more than one important flora and having monographed more than one genus; moreover he was for some years Assistant for India at the Kew Herbarium.

The first twenty pages of the book will not greatly interest the beginner in field botany though, from a scientific and general point of view, they are perhaps the most important of the book as they briefly review the several systems of classification of the higher plants and then develop a new phylogenetic system of the author's own conception. This system Mr. Hutchinson has already discussed in papers printed in the Kew Bulletin and I will only mention here that instead of depending, as have previous authors including the most recent, Engler and Prantl, on a single line of descent, Mr. Hutchinson considers that there are at least two parallel lines of evolution with offshoots which approach one another from both. This refers to the Dicotyledons, with which subphylum alone this book deals, and is made clear by a diagram. It is the remainder of the three hundred or so pages that will appeal to the field botanist as they contain an artificial key to all the families of Dicotyledons which I have found easy and simple to work with. Very great care and an immense amount of work have gone to the concocting of this key by the help of which no field worker should have any difficulty in running down a plant to its proper family. Each order and each family is briefly described, their main characters being indicated together with short notes on their distribution and occasionally of their uses. The numerous and excellent illustrations by the author and Mr. W. E. Trevithick (no less than 264, one species at least for each family, besides some maps showing the distribution of certain critical genera) add enormously to the value and the facility of use of the book. The volume is rounded off with a useful list of families possessing certain more or less constant and striking characters, *e.g.* glandular leaves, a glossary of terms and a full index. As already stated only the Dicotyledons are treated in this volume and a future one is promised for the rest of the flowering plants.

Workers in India may find, at first, a slight awkwardness in using this book from the fact that the families are not arranged

in the order of the Bentham and Hooker system which is that adopted by most of the local floras, and that the families are more numerous (264 for the whole of the world as against well under 200 in Bentham and Hooker). But in every case the corresponding family under which it appeared in the Bentham and Hooker system is indicated at the end of the descriptive portion. This is a very small drawback. It would have been convenient if in the key the page on which the description appears had been noted against each family and perhaps this will be attended to in another edition (and I prophecy that one or more will be needed) and in the eventual companion volume.

There is a commendatory foreword by Dr. A. W. Hill, F.R.S., the Director of the Royal Botanic Gardens, Kew, which indicates the appreciative attitude the scientific world is likely to adopt towards this excellent production. It only remains to say that the get up is as good as the matter and that the price is 20 shillings.

CECIL E. C. FISCHER, I.F.S.

London, 25th January 1926. *Retired.*

EXTRACTS.

ECONOMIC DEVELOPMENT OF BURMA.

Extract from a speech made by His Excellency the Governor of Burma at the Annual Convocation of the University of Rangoon on 10th February 1926.

The forests of Burma are one of its greatest assets. The whole policy of the Department has been examined. The view has been put forward that Government should undertake extraction and marketing on a larger scale than it has hitherto done. But enquiry has shown that this would not be profitable. The large firms working teak bring in roughly half the gross forest revenue of the province. They have sunk very large capital in elephants, buildings, launches and generally in opening up the forests, and the Government could not take their work over

without an enormous expenditure and probably a large amount of waste. As regards extraction of species other than teak, Government operations are concerned solely with the expansion of the market for the better known timbers and the creation of a market for the lesser known timbers, many of which have at present no market value. In the case of teak, it has been definitely decided to confine departmental extraction to the area drained by the Myitmaka river which has always been worked by the Forest Department. Efforts are being made to give Burmans and others opportunities for contracts wherever they can provide the necessary capital and ability to work the forests. I have already paid a tribute to the work which the firms have done in developing the province.

A committee has recently reported on certain aspects of forest administration. Its proposals are now being considered. In one respect we can claim to be pioneers. Burma, I am proud to say, was the first province to use the aerial method of survey. In 1923-24 at the instance of the Forest Department and especially of Mr. Watson, now Chief Conservator of Forests, a contract was placed for the aero-photo survey, under the control of the Survey of India, of 1,300 square miles of forest in the Irrawaddy Delta. The Survey of India co-operated enthusiastically and were able to utilise the results for the compilation of their one-inch topographical map of the area. The work proved a brilliant success and in the following year the Forest Department were allowed to use the organisation and equipment assembled for the purpose to carry out an aerial reconnaissance of the forests in South Tenasserim. Little was previously known of these forests. As a result of the season's work the broad distribution of the various forest types was sketched over an area of 15,000 square miles. It is estimated that to obtain the same results by ordinary methods would have involved some twenty years' work and cost almost three times as much.

The nature of the work, the risks involved, and the success achieved, have not, I think, been adequately realised. Had the personnel and the material concerned been other than of the highest order the work could not have been carried out. I do

not hesitate to say that it was a splendid piece of work. Cordial thanks and congratulations are due to the Survey of India, to Major C. G. Lewis, R.E., who was in direct charge of the survey of the Irrawaddy Delta, to Mr. R. C. Kemp, who supplied the personnel and equipment of the flying units, and to the officers of the Forest Department who co-operated and acted as observers throughout the difficult and dangerous reconnaissance work in South Tenasserim.—[*Rangoon Gazette.*]

MINISTERS AND THE FORESTRY COMMISSION.

House of Commons, 4th February 1926.

Mr. Johnston (Dundee, Lab.) during question time, called the attention of the Speaker to the fact that no Minister of the Crown was responsible in the House for the operations of the Forestry Commission, and that questions relating to afforestation had been repeatedly put and never answered. Mr. Baldwin explained that on the present occasion it was understood that a representative of the Commission was to answer the question on the paper (as to the appointment of a Commission to inquire into the possibility of growing pulpwood in this country), and he would make inquiries as to how it had happened that he was not in his place to do so. Mr. Maxton (Glasgow, Bridgeton, Lab.)—Will the Prime Minister see, in view of the extensions in forestry work outlined in the Agricultural White Paper, that in future there is a recognized responsible Minister, to whom we can direct these questions? Mr. Baldwin said he would take the whole matter into consideration. (Hear, hear.)—[*The Times.*]

THE LAC INDUSTRY.

Council of State, 10th February 1926.

Mr. Chadwick moved an official resolution providing for the continuance till the 31st December, 1931, of the imposition of the duty on lac exported from British India. He pointed out that the revenue would be devoted to scientific research and im provement of the cultivation of lac. If the case for the imposition of the duty was strong four and a half years ago it was

stronger to-day, and the need for its continuance was very great in view of the competition in its trade. After consultation with the Government of Bihar and Orissa a site was selected close to Ranchi where research work would be carried out. Continuity in this work was necessary in the interests of the industry. The resolution, if passed, would be a message of encouragement to the Lac Association which was engaged in grappling with the problems of the lac trade.

The resolution was carried.

The shellac industry is one about which very little is heard; yet it has to be regarded as one of the most important in India, the total value of exports during the last three years having amounted to over £17 millions. The industry, however, is threatened by increasing competition from synthetic substitutes made in Germany and the United States of America, and while these substitutes cannot replace the natural article for all purposes they are gaining ground owing to their cheapness. Special interest attaches therefore to the decision of the Council of State on Wednesday to continue the lac cess, which would ordinarily cease to operate at the end of 1926, for a further period of five years. The cess, which is akin to the tea cess, is quite small, and its administration is entrusted to the Lac Association, which undertakes research work found to be beyond the scope of Provincial Forest Departments, the object being to improve the quality and to cheapen the cost of production of the natural product.

(The Pioneer.)

BENGAL FOREST BUDGET ESTIMATES.

Calcutta, 19th February 1926.

In presenting the Budget estimates of the Government of Bengal for 1926-27, in the Bengal Council to-day, Mr. Donald (Finance Member) said :—

* * * * *

In the Forest Department we contemplate new expenditure amounting to about Rs. 3½ lakhs. This is required for the proper

development of our forests. We cannot get full benefit of our forest resources unless we open them out and obtain greater accessibility. We should in due course reap a considerable harvest as the result of this expenditure.

* * * * *

(The Pioneer.)

BRITISH TIMBER FOR THE NAVY.

Mr. Davidson, in a written reply to Mr. Hurd, says that the bulk of the supplies of timber for naval use are obtained from British and Dominion or Colonial sources. The classes of timber thus supplied include spruce, pine, elm, and fir from Canada, teak from Burma, mahogany from British Honduras, and *lignum vitæ* from Jamaica. Considerable supplies are also purchased of British home-grown timbers, including oak, elm, beech, and ash.

[*The Times.*]

WHITE ELEPHANT AT THE RANGOON ZOO.

Dr. Saw D. Po Min, President of the Karen National Association, Burma, who resides at Toungoo, has brought a White Elephant to the Rangoon Zoo for exhibition. This animal was captured by him some years ago, during the War. It is a very rare animal. A special house and enclosure for it have been erected in the Zoo by Dr. Po Min at considerable expense, where the animal is now comfortably housed. The building and enclosure is to the east of the rhinoceros and zebra enclosures. The public should not miss the opportunity of seeing this animal. The charges for admission to the special enclosure are 8 annas to the carpet and seating enclosure and 4 annas to the general enclosure. Children are charged half rates.—[*Rangoon Gazette.*]

BURMESE WOODS AS RAILWAY SLEEPERS.

A Press communiqué issued by the Government of Burma states:—

Experiments were commenced in 1910 to ascertain the durability of certain Indian timbers after treatment when used as

Railway Sleepers, and the results obtained have been published in the Government publications from time to time. The latest results based on the inspection reports of 1923-24 are now embodied in the Forest Bulletin No. 59 (Economy Series) written by the Officer-in-charge, Wood Preservation, Forest Research Institute, Dehra Dun, U.P. Many of the well-known Burmese timbers are among those experimented with, and the reports on the results obtained on some of them are also to be found in the above noted publication. The treatment given to the timbers consists of (1) Powellizing, (2) soaking the timbers in open tanks with Avenarius Carbolineum oil, (3) soaking the timbers in open tanks with Chloride of zinc and Green oil or Avenarius Carbolineum, (4) soaking the timbers in open tanks with Solignum or Green oil and Burma oil or Liquid Fuel, (5) painting the timbers under pressure with a mixture of Green oil and Assam Earth oil, (6) treating the timbers under pressure with creosote in England or America. Their durability as railway sleepers after treatment is tested by laying them in open lines of the different railways in India. Untreated timbers are also experimented with to find out their durability as railway sleepers, and a comparison of the durability of the timbers treated under different methods with that of the untreated timber shows important results. In the case of the Burmese timbers, the experiments mentioned in the Forest Bulletin No. 59 are concerned mostly with untreated timbers and the results of these experiments are as shown below:—

UNTREATED SLEEPERS.

Pyinma-pyu wood (*Lagerstroemia tomentosa*), average life about 5 years; *Taukkyan* wood (*Terminalia tomentosa*), average life about 6 years; *Thitsein* wood (*Terminalia belerica*), average life about 2 years; *Myaukchaw* wood (*Homalium tomentosum*) average life about 3 years; *Gyo* wood (*Schleichera trijuga*), life about 6 years; *Thitmagyi* or *Thitpyu* wood (*Albizzia odoratissima*) average life about 6 years; *Sibok* or *Sit* wood (*Albizzia procera*), average life about 10 years; *Bambwe* wood (*Careya arborea*), average life about 9 years; *Tinyu* wood (*Pinus Khasya*), average life about 2 years; *In* wood (*Dipterocarpus tuberculatus*), average

life about 9 years; *Kanyin* wood (*Dipterocarpus alatus*), average life about 6 years.

POWELLIZED SLEEPERS.

In wood (*Dipterocarpus tuberculatus*), longest life 12 years; *Kanyin* wood (*Dipterocarpus alatus*), longest life 12 years; *Taukkyan* wood (*Terminalia tomentosa*), the sleepers have been in line for over 12 years and are probably good for at least three years more. No white-ant attack.

CHLORIDE OF ZINC AND GREEN OIL OR AVENARIUS CARBOLINEUM TREATED SLEEPERS.

Kanyin wood (*Dipterocarpus alatus*), life 8½ to 9 years; *Taukkyin* wood (*Terminalia tomentosa*), life 9 years.

SOLIGNUM OR GREEN OIL AND BURMA OIL OR LIQUID FUEL TREATED SLEEPERS.

Taukkyan wood (*Terminalia tomentosa*), the sleepers have been for nearly 9 years in the line though there is no heavy traffic over them. Spike hold is good. There is no rail cut and no white-ant attack. All the sleepers are on embankments, the average annual rainfall in the region being in the vicinity of 40 inches. It is expected the sleepers will last another three years.—[*Rangoon Gazette.*]

FORESTRY AND AGRICULTURE.

The Agricultural Inquiry.

We have already expressed our satisfaction with the decision to appoint a Royal Commission on Agriculture and with the specially mentioned purposes which it is to keep in view, namely, to pick up the threads of the very successful work done by many agencies during many years for the advantage of agriculture and to co-ordinate them so that improvement may still further be stimulated and guided. The only criticisms of the proposals that we have seen are the Swarajist complaint that they are intended to draw the agricultural classes away from the pursuit of Swaraj, a statement which may fairly be read as a tribute to the sureness with which Government have envisaged

the outstanding rural need, and a cry, reflecting apparently, a communist line of argument, that the inquiry can do no good unless its terms are extended to include the possible overturn of the prevalent systems of land tenure. But in one direction the announcement made by His Excellency the Viceroy specially invites criticism. It tells us that the personnel of the Royal Commission has not yet been settled. On this point, then, we have while there is yet time a suggestion to make. The personnel of this inquiry must, unless it is to be seriously incomplete, include a Forest Officer of first-class Indian experience. The importance of forestry to agriculture has never in India received adequate recognition. The Irrigation Commission instituted by Lord Curzon included no Forest expert, though forestry and the water-supply of rivers are intimately related. The great Famine Commission of the same regimé contained none, though forest service is essential to famine relief.

The reason why the importance of forestry in this connection has never been acknowledged is the same as has continually dogged and handicapped the development of forestry in India since the British established peace in the land and the consequent increase of population increasingly raised the importance of the question. Its first part is the small attention paid to forestry in Great Britain, where whether forestry be practised or neglected the Gulf Stream assures an equable climate and regular rainfall and the coal mines provide ample, easily obtainable fuel. Its second part so shrewdly demonstrated by Stebbing, in the first volume of his "Forests of India," is the failure of the unscientific mind of the revenue service, which holds the prime direction of affairs to give sufficient weight to scientific considerations. The effect is seen both in the inadequate service which forestry now renders to agriculture in India and in the senseless conflict always going on between the agricultural classes and the requirements of scientific forestry—with the revenue officer too often taking the part of the former instead of playing the rôle of well-informed moderator between the two. Experts, we shall be told, whether Forest or otherwise, ought not to be on the Commission. Their function it will be said, is to give evidence and on the Commission itself

they would be out of place. That is a perfectly sound contention in regard to many inquiries and committees. But a Royal Commission is specially intended to be a Commission of Experts. In Great Britain that is well understood. And one of the greatest arguments in the present case is that the Commissions and Committees hitherto appointed for inquiries affecting agriculture in India, in which no expert forester has been included, have without exception failed to pay that attention to forestry as an adjunct to agriculture that ought to be paid to it, though the need to do so has again and again been pressed upon Government and the public and is in fact, very clearly, in indirect and uninterpreted ways ever before us.

The Indian Legislature never meets without Government being pressed by unofficial members to take measures to protect agriculturists from the havoc and loss constantly wrought by floods. No agricultural conference ever meets in India without bemoaning the Indian habit of using cattle dung for fuel instead of as manure, yet it has been proved to demonstration that the cultivators know what valuable manure they destroy when they burn dung, and that in rural tracts where they can conveniently get wood for fuel they do not burn dung but use it as manure. Great tracts of India are still described as waste land—forestry could turn them all to good account for the benefit of agriculture however rough and rugged they may be. The first scientific expert whom the Government of India after much contention with the Secretary of State, engaged to assist the improvement of Indian agriculture was Voelcker, the agricultural chemist and specialist, whom the Royal Agricultural Society of England lent for the purpose nearly forty years ago. He, after long and very thorough investigation, wrote a report of 540 printed pages which has ever since been quoted for its practical wisdom. He devoted one chapter almost entirely to the administration of the Forest Department and to showing how its work ought to be extended ' in a more agricultural direction than has been the case in the past." "Fuel and fodder reserves for the primary purpose of supplying wood to take the place of cowdung as fuel," and for the supply of grass, was a prescription for the Forest Department

which he placed in the forefront of his recommendations for agricultural improvement. Again and again he emphasizes "the further encouragement of arboriculture" as "one great need" of agriculture, and if it had been extended for that purpose as it might have been and as, indeed Sir Dietrich Brandis ten years earlier insisted that it ought to be, the improvement of cultivation would by now have travelled much further than it has. In some parts—for instance on some of the millions of acres of waste land in the United Provinces zemindaries—the work has been accomplished with great success. To set forestry in its full and proper relationship to agriculture would be a singularly happy reform to mark the Viceroyalty of Lord Irwin, whose grandfather was the Secretary of State who brought the Indian Forest Service into being, and the appointment of an experienced Forest Officer to the Royal Commission would be an appropriate and the most effective step in that direction.—[*Times of India.*]

TIMBERS OF THE BRITISH EMPIRE FOR THE BRITISH.

(Lecture by Mr. Alexander L. Howard.)

The second lecture of a series dealing with different phases of the timber trade, promoted by the Liverpool Timber Trade Association Ltd., was held on Wednesday evening, December 16th, in the large banqueting hall of the Exchange Station Hotel. The lecturer was Mr. Alexander L. Howard, London, who took for his subject "Timbers of the British Empire for the British." The lecture was illustrated by a large number of lantern slides; and Mr. Howard had also on view a fine selection of woods, mainly Burmese and Indian, to which he referred from time to time.

In introducing the lecturer, Mr. Alexander L. Howard, who is the agent for West Australia Government State Sawmills, the chairman, Mr. J. E. Harvey, J.P. (Messrs. Duncan Ewing and Co.) said it was very gratifying, though not surprising, to see such a large attendance, which indicated a desire to learn something new of the interesting and fascinating subjects. It was most desirable to learn one's business thoroughly, and this could

not be done without practical knowledge and hard work. Mr. Howard had taken for his subject "Timbers of the British Empire for the British," a subject with a vast horizon, and only a man like Mr. Howard, with his great mental calibre, could tackle such a subject. The chairman added that in Liverpool they got varieties of timbers from various parts of the Empire, such as Canada, West Indies, the East Indies, India, Burma Australasia, West Africa, and other countries, and the lecturer would reveal to them many things which they did not previously know, and which it would be to their advantage to become acquainted with.

Mr. Howard, who was cordially received, prefaced his lecture, which was admirably illustrated by a large number of splendid slides, by saying how pleased he was to again visit Liverpool, which he regarded as a great centre of the timber trade.

He said that the maximum amount spent by this country for imported timber was reached in 1920 when the colossal sum of close upon £82,000,000 sterling was paid. Out of this sum only £16,000,000 was paid to the British Dominions or within the Empire; the vast total of £66,000,000 therefore went to foreign countries helping to build up their financial position or assisting them if they wished to wage war against Britain, as they lately found. The figures for 1924, which had only just been published, showed a total import of just over £50,000,000, out of which British Dominions supplied £6,000,000, Canada contributing nearly £3,500,000, Australia £365,000 and India £911,000 leaving for 1924 a total of £44,000,000 which went out of the Empire.

Having referred to the increased imports from India, the lecturer asked whether they had sufficiently considered whether they could afford to continue in this way. Our present debt to America was no less a sum than £800,000,000 sterling, and according to a recent published report the total imports for November amounted to £115,000,000, while the exports only reached £61,000,000. Surely they ought to seek for a means of establishing a reciprocity so that instead of spending their

money outside the Empire they should spend it inside in exchange for trade from the Dominions. Those of them who had it within their power should exercise every possible effort in favour of British Empire timbers. Quoting Professor Seeley, who wrote "There is something very characteristic in the indifference which we show towards this mighty phenomenon of the diffusion of our race and expansion of our state. We seem, as it were, to have conquered and peopled half the world in a fit of absence of mind." Mr. Howard said that taking into account the enormous population of this small island, which must be fed, and the present temper of the people, what was the result to be?

Continuing, Mr. Howard said "As business men engaged in trade we, of course, recognise that we are bound to sell the timbers which people want, and therefore commonsense must prevail, but we can make a firm resolution that as far as we possibly can, we shall always put forward Empire timbers preferentially. An experienced timber salesman is often astonished at his success in selling some timber just because he resolutely determined he would." The history of the timber trade, added Mr. Howard, was one long experience of beautiful timbers produced in an excellent manner at extremely moderate prices and no buyers. In Liverpool some of them might remember the first importation of magnificent logs of mahogany from the West Coast of Africa. Between 1890 and 1894 London refused to have African mahogany altogether, meantime a few were buying it in ever-increasing quantities at ridiculously low prices in proportion to its real value, and he remembered a well-known person who himself had just measured 100,000 ft. of African panel board, informing him that no power on earth would induce him to touch African, and explaining the marvellous qualities of Honduras which he had taken. Yet in 1845, nearly 60 years after mahogany was first introduced, they found that 18 firms had to subscribe to a memorial to the British Admiralty imploring them to admit the use of mahogany in shipbuilding.

Pioneering of New Woods.—It was interesting to note that some of the names attached to this memorial were still well-

known, and the descendants of some were still engaged in trade. *Thomas Gabriel & Son, James Latham, Benjamin Ingram,* W. Oliver, were among the names. To-day it seemed astonishing that so much trouble should have been needed to make a beautiful timber like mahogany popular, but so it had always proved. Whether it was American walnut, American whitewood, Australian timbers, India or Burmese timbers, they had the same trouble. First there was a complete refusal to even look at the timber, but when it became known and was actually difficult to get and high in price there was an obstinate determination to have it. Sometimes so long as the buyer imagined he was getting the timber he asked for, he took little trouble to ascertain whether it was the real article, and he hardly ever put forward any effort to find whether it was economical, or whether there were not better timbers obtainable at less cost. During the last few years hundreds of thousands of pounds had been paid for decorative woodwork used in the rebuilding of Regent Street, and the so-called Italian walnut, American walnut, American mahogany, Austrian oak, and other foreign timbers had been almost exclusively used. Liberty's firm stood alone in having used Empire-grown teak.

Continuing, Mr. Howard said that in face of our present indebtedness to America, it was astonishing to find that British Railways, Government and Public departments, large municipal concerns as well as many other Corporations, demanded American sawn walnut, American sawn whitewood and American sawn mahogany.

American walnut was not a bad wood, but on the other hand it was not a good wood. It had no character to recommend it; it was indifferent in quality, and it had no virtue to warrant the high price which had now to be paid for it; in fact, British-grown beech would give just as good an appearance and wear as well. American whitewood was a valuable timber, but it contained no special quality which made it necessary for them to purchase it to-day. Everyone knew the good qualities of American sawn mahogany, but they must think of the money paid to America and the American labour for all this wood. The minimum wage

paid to labourers in the lumber industry in America was 2s per hour, and sawyers were paid a minimum of £600 per annum. The cost of delivering timber from the sawmills to sea-board was fifteen dollars per thousand feet super., equal to nine pence per foot cube. Other costs of production were on a similar basis, and all the work carried out had to bear a proportion of the high charges prevailing in America, and all this cost was paid to the American labourer, and accordingly our own labour lost the work. It was small wonder, therefore, that the passenger and traffic receipts of our railways should have fallen off, and that they had over a million unemployed. Railway stock throughout could be built of Empire-grown woods, including the decorative woodwork, with quite as good and even better results at less cost, and their own people be kept employed.

Availability and Utility of Empire Timbers.—Proceeding to draw attention to the opportunities afforded to-day for the uses of Empire timbers, Mr. Howard said in British Columbia and all over Canada were vast stores of timbers which might be brought more generally into use. Western Australia, with its magnificent jarrah and karri timbers, were provided at the present moment in the highest possible quality at most moderate prices, but these timbers were insufficiently patronised everywhere. This was largely due to the fault of the Western Australian Government, who failed to use any sufficient means of popularising their timbers or to keep any stocks available for use in this country. Other valuable Australian timbers and the timbers of British Guiana, Borneo, and the Malay Peninsula, and several other places could be far more exploited, but as his attention for the past few years had been concentrated upon India and Burma, he would confine his remarks principally to the new timbers of India and Burma, of which he had had panels specially prepared for their inspection. Proceeding, Mr. Howard said that in 1920, before he went to India, the then Secretary of State, who was enthusiastically interested in the development of the timbers of India, said to him, after seeing the 1920 Empire Timber Exhibition, "You have done your part; I hope that the people out in India will do

theirs." He was convinced that much greater things could be done with our own Empire resources than had hitherto been dreamed of, and only let the demand for British Empire timbers be established, the supplies would certainly be assured. Having referred to the immense forest areas within the Empire, Mr. Howard said that from forests such as these and with a proper forest organisation which ought to exist in every country, there could be no doubt as to the future if they followed the practice of the great French Minister, Colbert, who established marvellous forests in France. The lecturer then, with the assistance of a lanternist, gave most instructive help to his audience by the means of a large number of excellent slides dealing particularly with the title of his lecture.

At the conclusion, a hearty vote of thanks was accorded to Mr. Howard at the call of the chairman, who was himself thanked for his presidency of the meeting.—[*The Timber News.*]

A SHIKAR ADVENTURE.

Lady's Terrible Experience.

We publish below an account by Mr. E. A. Smythies of the Forest Department, United Provinces, of what must have been one of the most exciting and most unpleasant adventures in the history of big game shooting in India :—

We were staying for Christmas in a good shooting block and one night we had a kill by a tiger in one of the best small beats in the area. So my wife and I went off to the beat; and I fixed up two machans, my own in front, and her's about 40 yards to the right and behind, thus avoiding the risk of ricochets. Her machan was in the first fork of a tall, cylindrical tree, 14 feet from the ground, the tree being 4 to 5 feet in girth. Just in front of my machan was a patch of heavy narkal grass about 25 yards in diameter, and there was a good deal of grass and undergrowth all round. Soon after the beat started, I heard a stop clapping, and the tiger roared twice. About three minutes later, I heard it coming through the narkal grass, and presently it broke cover at a fast slouch. My weapon was a H. V. 404

Jeffery magazine rifle, with which I have killed several tigers. I had four cartridges in the magazine and chamber and some more loose on the machan. As the tiger broke, I fired and missed, and it rushed back to the narkal. Presently the beat came up to the narkal, and almost simultaneously the tiger again broke cover, this time at full gallop with a terrific roar. I fired at it going away on my left, and again missed. The beast went by my wife's machan at the gallop about 30 yards from her, and as soon as it had passed her, she fired and hit it about six inches or so above the heart and just below the spine. This stopped it, and it rolled over roaring.

A MISFIRE.

Here the incredible part of the story begins. The tiger mad with rage turned round, saw her in the machan, and made for her climbing the tree for all the world like a huge domestic cat with its fore-arms almost encircling it. Up it went vertically under her machan, and as I turned round hurriedly I knocked the loose cartridges out of my machan to the ground. As things were, I had no option but to take the risk of hitting my wife. I fired at the brute when it was half way up the tree, but only grazed it. As I looked down to work the bolt and reload, I realised I had one cartridge left, and looking up again I saw my wife standing up in the machan with the muzzle of her rifle in the tiger's mouth—his teeth marks are 8 inches up the barrel —and he was holding on to the edge of the machan with his forepaws and chin. In this position she pulled the trigger—and had a misfire. You must realise that at least two-thirds of the tiger's weight was now on the machan, for except for his back claws, he was hanging out from the tree by the width of the machan which was rocking violently from his efforts to get on to it. The next thing I saw was my wife lose her balance and topple over backwards, on the side away from the tiger.

THE LAST CARTRIDGE.

The beast did not seem to notice her disappearance, and as I again aimed at him, I saw him still clawing and biting the

machan—the timber was almost bitten through, and the strings torn to shreds. I fired my last available cartridge, and by the mercy of Heaven the bullet went true. It took the tiger in the heart and he crashed over backwards on to the ground immediately below the machan, where he lay hidden from view in the grass. I did not know at the time he was dead : nor of course did my wife. All I knew was that my wife had disappeared from the machan on one side of the tree and the tiger on the other, that I had no cartridges left; and that I was helpless for the moment to give any further assistance.

Whether my predicament was as bad as my wife's can be judged from her view of the incident. I quote her words : — "When I fired again, he turned round and saw me, and immediately dashed roaring towards my tree. I thought he was galloping past, but suddenly realised he was climbing up, and only just had time to stand up in the machan before his great striped face and paws appeared over the edge, and his blood and hot breath came up at me with his roaring. I pushed the barrel of my rifle into his mouth and pulled the trigger, but the rifle would not go off. Then I really did feel helpless and did not know what to do. We had a regular tussle with the rifle, and then I saw his paw come up through the bottom of the machan. In stepping back to avoid it, I must have stepped over the edge of the machan as I felt myself falling. I thought I was falling into the jaws of the tiger, and it flashed through my mind, 'Surely I'm not going to be killed like this.' I never felt hitting the ground at all, and the next thing I knew was that I was running through grass and over fallen trees, wondering when the tiger would jump on me."

She arrived at my tree almost simultaneously with the mahout, Bisharat Ali, who had rushed up his elephant regardless of wounded tigers or anything else and she hastily mounted and cleared off into safety, unhurt except for a sprained wrist, and various scratches and bruises from the fall. One of the stops was calling out that he could see the tiger, and it was lying dead under his machan. So when a supply of cartridge arrived, I went up cautiously and verified his statement, recovered my

wife's hat and rifle, and went off with her to the bungalow leaving the stops to bring in the tiger.

It was a nice male 9 feet 3 inches in length, with three bullets in it, one between heart and spine, one cutting the bottom of the chest, and one in the heart. It will be a long time before we try and get another! This is a plain unvarnished account of an incident which must, I think, be unique in the annals of tiger shooting. At least I have never heard of a lady being hurled out of a high machan by a climbing tiger, and her husband killing it up in the air with his last cartridge.—[*The Pioneer.*]

PICTURES BY THE LATE D. H. M. SILVANUS, I.F.S.

EDINBURGH:
Special Correspondence.

A two-man show, the work of Nicol Laidlaw and of his friend Hubert Silvanus, was recently opened in Edinburgh.

Mr. Silvanus was in the forestry service in Burma, and as an enthusiastic amateur was active in the little art colony there. In spite of the demands of his work, he managed to develop his gift for painting, and when a long deferred leave enabled him to throw himself whole-heartedly into the study of art he made rapid strides.

The exhibition—really a memorial one—has been arranged by Nicol Laidlaw, whose own work, especially as a portrait painter, is rapidly becoming known. Mr. Laidlaw works in the Raeburn studio in Edinburgh. Some of his portraits in this exhibition have been seen already in the Royal Academy and in the Royal Scottish Academy. It was in Skye that the two artists met and recorded their impressions of that island.

Many of Mr. Silvanus' subjects, naturally, are Indian, and he has caught the atmosphere and eloquently expressed the splendour and brilliant colouring of the East. Even in the misty isle of Skye he still retains this richness of colouring. His studies of the Cuillin hills are altogether satisfying. There is distinction, design and fine colouring in his work.—[*Christian Science Monitor.*]

PAPER FROM EUCALYPTUS.

A discovery, possibly of great economic significance, is reported from the University of Wisconsin as the outcome of experiments for substituting the wood of the eucalyptus for that of the spruce as a material for making newsprint paper. The experimenters have made paper from eucalyptus grown in São Paulo, Brazil, which is said to have excellent printing quality and to be strong enough to be used on high-speed presses.

It is estimated that such paper can be produced at about half the cost of the present imported variety, and it is expected that the new invention will bring paper manufacture into prominence in Brazil.

The eucalyptus grows readily in California, New Mexico, Arizona, and Florida, and because of the climate in those States trees could probably be brought to pulpwood size in less than ten years. The United States at present is largely dependent for newsprint and wood pulp on imports from Canada and, to a smaller extent, on the Scandinavian countries. Newsprint imports from Canada alone in the first ten months of 1925 amounted to more than 2,155,000,000lb., valued at $78,404,000 (£15,680,000).—[*The Times.*]

JARRAH FOR INDIAN SLEEPERS.

BURMA INDIAN CHAMBER OF COMMERCE.

The following telegram was sent by the Burma Indian Chamber of Commerce on the 13th February to the Railway Board, Delhi :—

" Referring notice of tenders for supply of two lakhs twenty-nine thousand Jarrahwood sleepers invited by Great Indian Peninsular Railway published " Indian Trade Journal " of 4th instant. Committee Burma Indian Chamber of Commerce strongly protest against practice of inviting tenders for foreign sleepers although teakwood and junglewood suitable for railway available in abundance in India and Burma. Committee consider such

practice in absolute contravention of accepted policy of Government regarding purchase of stores for public services especially as Railway concerned is now under state management. They respectfully urge Railway Board to take immediate steps to undo injustice done in this instance to country's interests concerned."—[*Rangoon Gazette.*]

THE QUESTION OF ALL-INDIA AND PROVINCIAL SERVICES.

BURMA FOREST COMMITTEE'S REPORT.

The Government of Burma's Resolution on the Report of the Forest Committee, 1925, says,—

The Government of Burma (Ministry of Forests) has read with great interest the Report of the Committee appointed in September 1924 to consider the organisation of the Forest Department and to examine the policy of the Government generally with regard to the grant of rights of extraction of timber and other forest produce and the methods of collecting revenue. The ministry tenders its thanks to U Pu, M.L.C., and the other members of the Committee for an excellent report that is full of valuable suggestions.

With the greater number of the recommendations contained in the Report the Local Government finds itself in substantial agreement; they will all be examined in detail as early as possible. While ordering the publication of the Report there is however one recommendation which the Local Government cannot pass over without comment. This is the proposed amalgamation of the All-India and Provincial Forest Services dealt with in paragraphs 68 to 73 of the Report. These proposals scarcely fall within the terms of reference to the Committee; witnesses were not specially examined on this subject nor have detailed proposals for the amalgamation of the Services been worked out, and the Local Government finds it difficult to understand what the Committee had in mind In any case, proposals of this nature cannot be considered until orders have been received on the Lee Commission's Report. Further than this it is

not possible to say at present, except that the Local Government has noticed with satisfaction that the Committee agree in being unable to recommend any lowering of the standard by which fitness for promotion to the All-India Services is judged.--[*Rangoon Gazette.*]

FOREST DEPARTMENT EXPENDITURE.

ASSAM COUNCIL.

Expansion of Resources.

Shillong, 2nd March.

The Assam Legislative Council, to-day, adopted Mr. Botham's motion for a supplementary demand for an additional sum of Rs. 2,65,000 for the Forest Department. A Swarajist motion for refusal of the demand was defeated.

Mr. Botham (Finance Member) explained that the amount was necessary to cover additional expenditure incurred by considerable expansion of the forest resources during the year. The completion of the forest tramway had greatly facilitated extraction. Operations, both departmental and otherwise, had expanded more rapidly than was anticipated. In particular there had been a large extension of the system whereby sleepers extracted by contractors were purchased by the Government and sold by the Government to the railways. That system, which was convenient both for the railway and for individual contractors, involved heavy expenditure which was recouped immediately. Greater expenditure on marking, on construction of roads and bridges, on loading and unloading trucks and other branches of the work was also rendered necessary by the larger operations. Communications and buildings had proved insufficient, and it was necessary to augment them by an additional grant of Rs. 2 lakhs.--[*The Pioneer.*]

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REGENERATION OF *HALDU* (*ADINA CORDIFOLIA*.)

Before the signing of an agreement a few years ago to supply *haldu* trees annually from the United Provinces forests to the Bobbin Company near Bareilly for a period of 20 years, there was only a small local demand for the timber of this species for use in house-building. To fulfil the agreement a very large proportion of utilisable trees will have to be removed, and, apart from the æsthetic point of view of the loss to the forests of so many of one of their most beautiful and comparatively scarce species, it is important from the business aspect to ensure a sufficient supply of this timber for the future. It is found, however, that in forests composed chiefly of miscellaneous species where mature *haldu* trees are best represented, those in the sapling and pole stage are in most cases extremely scarce or even altogether absent. Considerable attention has, therefore, been paid of late years to the matter of reproduction by artificial means, since it seems evident that the addition of grazing by large herds of cattle to the difficulties of regeneration already encountered in nature has eliminated the one chance in about 50,000,000 of any particular seed eventually producing a tree !

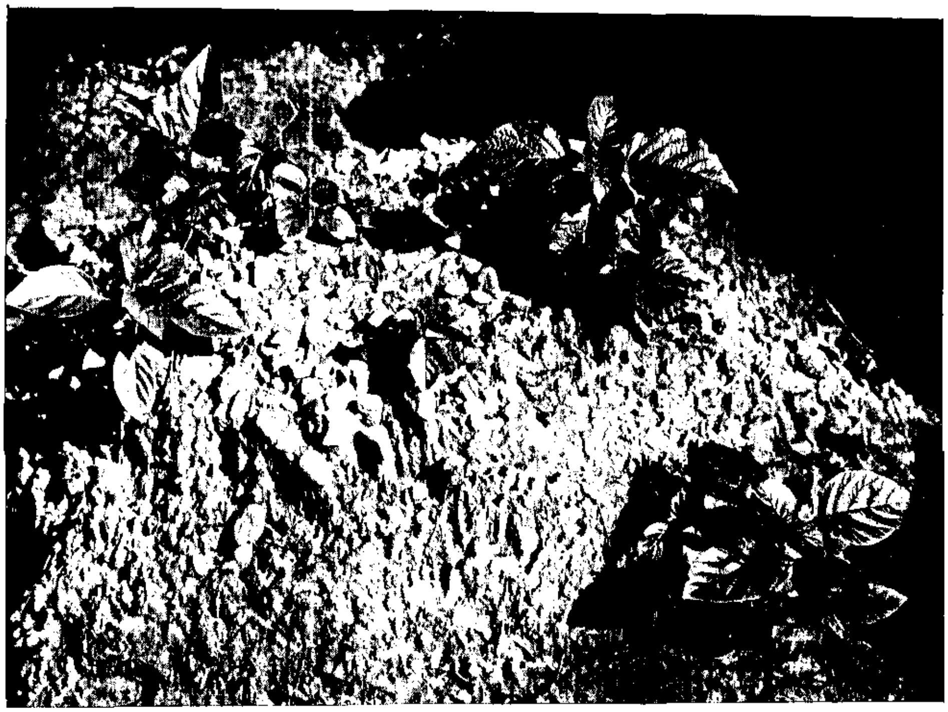
First year seedlings are seldom seen in the forest; partly because they are so small, but chiefly because they have already succumbed to one of their numerous enemies. Where they are noticed, however, is usually in the vicinity of bouldery water-courses or sometimes nestling beneath the remains of a half burnt log, and it would not be unnatural to conclude that chemical properties common to both newly deposited soil and wood ashes are the essential factors for successful germination.

But seedlings will also often be seen on stony soil piled up along freshly dug pits or ditches, and the more probably correct answer seems to be a combination of two physical requirements :—The first is some obstacle to prevent the tiny seed from being washed away, which the slightest film of water over the surface of the ground will otherwise do. The second is an absence of grass and weeds while the minute seedling—at first scarcely visible to the naked eye—is making its initial bid for life.

These conditions are afforded by both the bare stony ground in or near the upper courses of river-beds and freshly turned bouldery soil ; also by the half burnt log round which weeds will have been temporarily killed by fire.

But even assuming that one of the above favourable resting places has been found, the seedling's troubles are by no means over ; and even if it manages to get beyond the "mustard and cress" size before sufficient weeds have arrived to swamp all further efforts, and has done really well by attaining the magnificent proportions of 1" in height and between 1" and 2" across by the end of the rains, there are then nine months to follow during which some herbivorous animal may spy the tasty morsel and summarily end the chapter. Here again, however, the comparatively bare nature of its immediate surroundings provides further protection, in that would-be destroyers are inclined to turn aside to more apetising looking grazing grounds. Then finally comes the trial by fire in the form of the hot weather sun, which only the most exceptionally well developed seedling is able to stand. Although in nature seedlings thus, by force of circumstances, appear in such unattractive looking places, it is not necessarily to be assumed that, if given every opportunity, better results would not be obtained elsewhere ; and, since *haldu* is of considerable importance in the Tarai and Bhabar Estates experiments in plantations have been going on for some years.

At first these were of a more or less nominal character, *haldu* seeds being included with those of a number of other species in attempting to restock a very open piece of forest. But the area



No. 1. A mound in the Bhabar with several 5" Haldu seedlings.

No. 2. Haldu plants 16 months old up to 2' 4" in height.

selected borders on the Tarai and the enormous grass was found impossible to deal with during the rains.

Transplanting one year old seedlings so as to avoid the weeding difficulty was tried without any success, and sowings on mounds were again restored to in the following year in an adjoining area slightly further removed from the Tarai. Even so it was impossible to keep pace with grass that kept on shooting up from rhizomes left in the earth forming the mounds.

Finally in 1924 pits were dug in the cold weather and the earth from them was left exposed till May, when it was put back to form mounds as before, the dry grass rhizomes being easily separated out during the process. At the break of the rains *haldu* seeds were sown in the mound, the flat tops of which being encircled with a ring of pebbles. This time no grass appeared and creeping weeds were all that required to be dealt with.

At the same time a similar experiment was being started well up in the Bhabar, the only difference being that, instead of the ring of stones, the whole of the surface soil was mixed with them.

By the end of July nearly all the mound of both areas were covered with small seedlings. Many of these disappeared during the following three months, but at the end of the rains 10—20 remained on most mounds, varying in size up to 3½" across and 2½" high in the southern area, while in the Bhabar proper there was a good percentage of plants of 5" across and 4" high. The largest measured was 11" across and 9" high, and had 14 leaves!

It was then to be seen how many would survive the hot weather, but unfortunately the test was perhaps not quite a fair one as the rains of 1925 broke early. However, the results were good and may as well be given :—In the Tarai area 3—5 plants remained on most mounds and attained an average height of about 12" by the end of the next rains; but the wire enclosure was insufficiently high and every respectable seedling was grazed down by *chital* before photos could be taken. Fig. 2 (Plate 5), however, shows one of the best Bhabar mounds on which there are 8 plants, the largest of which measures 2' 4" in height. Nilgai had got into this area also during the previous cold weather and

destroyed the giant seedling already mentioned, before the wire was made sufficiently high to prevent further damage.

The outstanding points of the past years' experiments are :—

(1) Stones should be mixed with the surface soil of the mounds to prevent the seeds from being washed away.

(2) A very thorough weeding in July and August is essential.

(3) A break in the rains of several days duration, before the seedlings have got beyond the "mustard and cress" size, will cause them to die.

(4) Continuous rain with no short breaks of sunshine will result in no germination.

(5) Drips from the over-hanging branches of trees will badly erode the mound and wash away the seeds; or else splash earth over and suffocate existing seedlings.

(6) Wire fencing under 5′ in height is of no use for keeping out deer and nilgai.

Before putting my signature to this article a word of praise is due to Murari Lal, Ranger, whose enthusiasm and energy throughout the experiments are mainly responsible for the success eventually achieved.

B. H. OSMASTON, I.F.S.

SMYTHIES' MODIFICATION OF THE FRENCH METHOD OF 1883.

One of the chief objections against the adoption of the French Method of 1883 for calculating the possibility of forests in India consists in the difficulty of ascertaining the volumes of the mid-wood and the old wood before the normal relation (3 : 5) between them can be adjusted. The procedure involves the tallying down of all trees up to a diameter corresponding to one-third the rotation age, which varies both with the quality and the rotation. It is obvious that the diameter corresponding to

one-third the rotation will not be necessarily 8 inches which, apart from being the merchantable diameter, is also the recognised lower limit of enumerations in India. Although the French Method is an ideal method to be adopted in the calculation of the possibility of the Indian forests, the bulk of which are essentially selection, it has not received the attention it deserves, since its application would upset the conventional orthodox limits of enumerations which, in India, are carried out in 4-inch classes starting from 8 inches upwards.

To meet this objection against the applicability of the French Method to the Indian conditions, Mr. Smythies* has worked out the general case of a normal forest and from the geometry of similar triangles has arrived at the following proportions :—

$$4x^2 : (r+3x)(r-x) : (3r+x)(r-x),$$

which normally exist between the small wood, the mid-wood, and the old wood. The application of this general formula renders it possible to calculate the normal proportions between the volumes of the mid-wood and the old wood in the general case where enumerations have been carried out down to any diameter corresponding to an age x which may be any part of the rotation r. This interesting modification of the French Method has certainly a claim to superiority over the old method inasmuch as that it gives a free scope to the working plan officer in choosing the lower limit of enumerations and does not tie him down to the diameter corresponding to one-third the rotation. Thus, the lower limit of enumerations, *i.e.*, 8 inches may be retained in all cases and the normal proportions may yet be determined by substituting the age x corresponding to this diameter, which will vary with the quality of the locality, and the rotation r in the general formula given above. In effect, this formula achieves little beyond making it possible to stick to 8 inches as the lower limit of enumerations and introduces mathematical calculations in bargain which more than balance the advantages, if any, of adhering to the 8-inch diameter limit. For after all, the 8-inch limit is merely conventional and there does not seem to be any valid reason why

* E. A. Smythies, *Indian Forester*, September 1925, pp. 460—464.

it should not be less or more. Considerations of convenience in the field work are entirely ruled out when it is remembered that in spite of retaining the lower limit as 8 inches, no manner of control can be exercised on the next diameter limit up to which the enumerations are to be carried out for the calculation of the volume of the mid-wood, while the highest diameter for the old wood is fixed by the rotation and neither of these two limiting diameters need coincide with 4-inch diameter classes. The claim that the application of this formula will facilitate enumerations in 4-inch classes, it will be seen, cannot be substantiated in actual practice.

A hypothetical case of a first quality sal forest will serve to illustrate my point. For the rotation (r) 90 years, according to Mr. Smythies*, the enumerations should be carried out between 8 inches and 14·9 inches for the mid-wood and 14·9 inches and 20·1 inches for the old wood. It will be obvious that neither of the limiting diameters (14·9 inches and 20·1 inches) coincide with the 4-inch diameter classes and consequently enumerations between these limits, which will vary with the quality as well as with the rotation, are by no means simpler than those which the French Method involves. For the French Method† the enumeration limits would be for the mid-wood and the old wood, 8·7 inches to 15·2 inches and 15·2 inches to 20·1 inches respectively. The fact that in Mr. Smythies' method the enumerations are to be carried out between 8 inches to 14·9 inches instead of 8·7 inches to 15·2 inches can hardly be claimed to facilitate enumerations, since in neither case the conventional 4-inch diameter classes could be adhered to and it readily follows that callipers

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* *Smythies' Modification.* —

1. The age corresponding to 8 inches : 27 years. (x).
2. The diameter corresponding to $x + \frac{r-x}{2}$ or 58·5 years : 14·9 inches.
3. The diameter corresponding to rotation 90 years : 20·1 inches.

† *The French Method.*—

1. The diameter corresponding to $r/3$ years = 8·7 inches.
2. The diameter corresponding to $2r/3$ years = 15·2 inches.
3. The diameter corresponding to r years = 20·1 inches.

Vide A Sal Yield Table for the U P., by Smythies & Howard. Curve No. 6.

coloured for standard diameter classes are equally unsuitable for enumerations if the French Method as modified by Mr. Smythies were to be adopted.

Attention may also be drawn to the fact that Mr. Smythies' modification would give the possibility for a period of $\frac{r-x}{2}$ years which would be, more often than not, a very inconvenient number for prescribing the possibility. For example, in the case mentioned above the possibility would be fixed for 31·5 years! Fixing the possibility as it does, for a period of one-third rotation which is usually a round number, the French Method has a decided advantage over its rival.

The plea for sticking to the 8-inch diameter limit, since it coincides with the merchantable diameter, does not constitute sufficient reason to justify the adoption of Mr. Smythies' modification, for, the possibility is logically to be extracted from the old wood on the basis of which it is calculated, and fellings round about the diameter corresponding to one-third rotation are not likely to effect the possibility by being unmerchantable. Referring again to the hypothetical case given above the yield is based on the volume of the old wood between the diameters 14·9 and 20·1 inches (according to Mr. Smythies' formula) and the fellings must, therefore, necessarily be confined to these limits. It would be obvious that the question of unmerchantable diameters does not arise at all in actual practice as far as the extraction of annual yield is concerned. Under normal circumstances, hardly any fellings are to be carried out of trees corresponding to one-third the rotation (8·7 inch diameters in the present case) unless it is for thinnings. And if thinnings are counted towards the yield they are not likely to upset the yield in any way if a negligible portion of them happen to be unmerchantable, for after all thinnings are governed by silvical considerations and not economic. Fixing the merchantable diameter limit as 8 inches does not imply that thinnings will not be carried out amongst trees under 8 inches for the simple reason that they are uneconomic.

M. D. CHATURVEDI, I.F.S.,
Silviculturist, U.P.

CHARCOAL MANUFACTURE BY THE PARABOLOIDAL OVERGROUND KILN METHOD

In the April 1925 number of the *Indian Forester*, a short article appeared on the comparative costs of charcoal manufacture by (*a*) The Hornby kiln, and (*b*) The Paraboloidal Overground kiln.

In this article the writer has favoured the former method of preparation, and since the manufacture of charcoal in this Division is being carried out by the latter method, the following details may be of some interest.

Charcoal is being manufactured departmentally in three Ranges of this Division, the most important operations being in the Mahableshwar Range. Under the provisions of the special Working Plan for this Range, the preparation of charcoal has been restricted to the more inaccessible coupes of the valley Blocks.

The following brief summary will give some idea of the progress of this work from the date of the commencement of charcoal operations in October 1923.

1923-24 *(October—October).*

A sub-coupe was worked under a system of Heavy Improvement Fellings and 46 tons of charcoal prepared departmentally and carted to Malcolmpeth (10 miles) where it was sold at Rs. 2-4-0 per 80 lbs.

1924-25.

Another sub-coupe was similarly worked and 54 tons of charcoal prepared. Of this amount 38 tons were carted to Malcolmpeth and sold as in the previous year. The remaining amount (*i.e.*, 16 tons) was carted to Panchgani (22 miles) with the object of selling it at the same rate as at Malcolmpeth, but owing to the extra cost and difficulty of carting, this experiment could not be considered a success.

1925-26.

Another sub-coupe is now being worked under a system of Light Improvement Fellings (the Working Plan having been revised). By the end of the current working season 107 tons of charcoal will have been prepared departmentally. Of this

amount 50 tons are being carted to Malcolmpeth and sold departmentally at Rs. 2-4-0 per 80 lbs.

The remaining 57 tons are being taken *in situ* by a Panchgani contractor. In order to increase the sale of charcoal, while at the same time avoiding the extra cost and difficulty of carting to Panchgani, I fixed up a contract under the terms of which the contractor agrees to purchase *in situ* not less than 57 tons of charcoal during the year ending in October 1926. This contract increases the charcoal revenue for this year to the extent of Rs. 2,640.

The following data will show more clearly the steady increase of revenue which is being derived from charcoal manufacture in this Range. The other Ranges are also gradually increasing their outturns in proportion to the local demands :—

Year (October to October).	Total quantity of charcoal prepared. Tons	Cwt.	Qrs.	Lbs.	Actual expenditure incurred. Rs. a. p.	Actual Revenue derived Rs. a. p.	‡ Nett profit. Rs. a. p.	Remarks.	Rs. a. p.
1923-24 ...	46	13	2	2	*1,270 8 3	2,821 10 0	1,551 1 9	*Felling and Preparation charges @ Rs. 20·6 per ton ...	964 0 3
								Cartage from Coupe to Malcolmpeth (10 miles) @ Rs. 6·6 per ton	305 15 0
1924-25 ...	54	14	0	10	*1,565 12 9	3,367 5 3	1,801 8 6	*Felling and Preparation charges @ Rs. 21·01 per ton ...	1,149 7 0
								Cartage @ Rs. 7·6 per ton ...	416 5 9
								(This includes cartage of 15 tons to Panchgani—22 miles).	
1925-26 ...	107	2	3	12	*2,592 8 0	5,790 0 0	3,197 8 0	*Felling and Preparation charges @ Rs. 21·6 per ton ...	2,312 0 0
								† Cartage charges @ Rs. 5·6 per ton	280 0 0

† (This only concerns the 50 tons carted to Malcolmpeth and sold departmentally—the remaining 57 tons are being taken *in situ* by the Panchgani contractor.)

‡ These figures represent the *true* nett profit—the remaining sources of expenditure being disposed of as follows:—

(*a*) *Cost of material used in preparation—Nil.*

A large surplus of fuel - unsaleable, except as charcoal, owing to distance from markets—exists in these coupes.

(*b*) *Cost of establishment—Nil.*

The services of the protective establishment are utilised for supervision work—no extra expenditure is being incurred.

In order to ascertain the exact yield of charcoal prepared by the Paraboloidal Overground kiln, an experimental kiln was prepared recently and carefully weighed before, and after burning. The result obtained was as follows :—

Weight of wood used in kiln.	Weight of resultant charcoal.	Percentage outturn of charcoal to wood.	REMARKS.
3,580 lbs.	1,093 lbs.	30	Weight of large pieces of charcoal ... ... 928 lbs. Weight of small pieces passed through 1" mesh sieve ... 60 " Weight of charcoal from partially burnt wood 105 " Total ... 1,093 lbs.

METHOD OF PREPARATION.

(1) *Species used*—

The principal species used are as follows :—

Ain (*Terminalia tomentosa*).

Anjani (*Memecylon edule*).

Jambul (*Eugenia Jambolana*).

Kindal (*Terminalia paniculata*).

Nana (*Lagerstrœmia microcarpa*).

Awli (*Phyllanthus Emblica*).

Of these, the best charcoal is obtained from Ain and Anjani—but, owing to the system of felling and the consequent variation in the proportion of species felled, the kilns have necessarily to be prepared from mixed species. After felling, the trees are cut up into 3′ billets and stacked near the site of the kiln.

(2) *Selection of sites*—

This is influenced by the following factors :—

(*a*) The sites must be chosen in sufficiently open areas in order to prevent damage to the surrounding tree growth.

(*b*) Artificial regeneration is subsequently carried out in the kilns beds, the sites have, therefore, to be selected with this object in view.

Having chosen a site, the ground is then levelled to an area approximating 40′ in circumference.

(3) *Construction of kiln—*

(*a*) Three large stones (1′ × ½′) are placed to form a "Chula" (fire-place). These stones are kept in position by means of 4 pegs driven into the ground (*vide* sketch A, Plate 6). A sufficient quantity of inflammable material is then laid across this "Chula."

(*b*) The larger size billets are then stacked vertically, inclining slightly inwards, directly on the ground around this Chula, until the whole base of 40′ circumference is covered except for a narrow opening which communicates with the Chula.

(*c*) Upon this first layer two large billets (about 4′ long) are laid horizontally—against these a further layer of smaller 3′ billets is stacked vertically, inclining inwards, similar to the bottom layer.

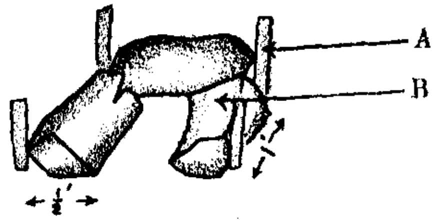
Great care must be taken to ensure that both these layers are tightly packed, in order to exclude as much air as possible.

(*d*) The kiln is then covered and "rounded off" with smaller branches down to 6″ girth to form a paraboloid cone in height about 5½′—6′.

(*e*) This structure is then completely covered with branchwood, leaves and grass, and finally surfaced with earth to a depth of approximately 3″.

(*g*) A stone wall, about 2′—3′ in height, is erected around the kiln to prevent the billets from slipping during the burning. Upon this wall of stones a layer of thick billets is laid horizontally, to keep the stones in position and to support the outer covering of earth.

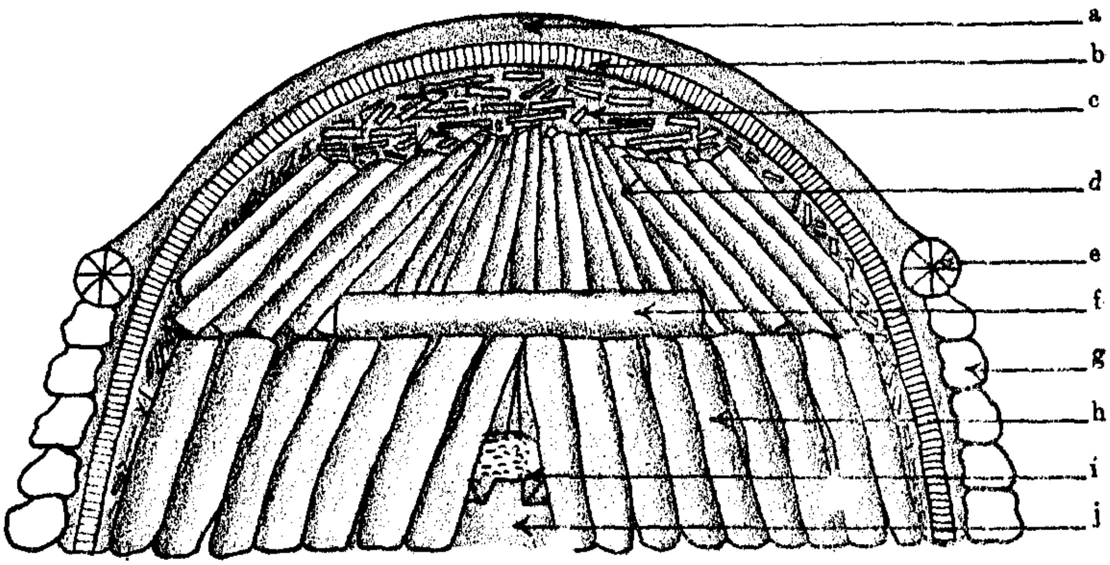
SKETCH A (Chula).



A—pegs to keep stones in position.

B—stones of suitable shape 1' × ½'.

SKETCH B (Kiln).



a—Surface covering of earth, approximately 3" in depth.

b—Branchwood, grass, leaves, tightly packed to exclude air.

c—Small material down to 6" girth for "rounding off".

d—Upper layer of thinner 3' billets.

e—Outer layer of billets to keep stones and earth in position.

f—Large horizontal 4' billet for support.

g—Stone wall for supporting kiln.

h—Bottom layer of large 3' billets.

i—"Chula" (fire-place) with inflammable material ready for ignition.

j—Fire hole, closed at the end of first day.

The kiln is now ready for burning. (*Vide* sketch B, Plate 6).

Burning—

The kiln is fired through the opening left which communicates with the Chula.

For the first hour or so the kiln "sweats" and gives off pungent acrid smoke, at the same time carbonisation commences. This "sweating" continues for the first day, at the end of this period the hole communicating with the Chula is closed.

The burning usually takes three complete days varying according to the size of the kiln and state of the weather. Two men are continually on duty, night and day, to regulate the course of the burning by closing openings with wood, leaves, earth, etc., when flames appear showing unnecessary combustion, and also by opening vents with a stick where necessary, to equalise the rate of carbonisation throughout the kiln and closing these up again when this object has been accomplished. This latter operation is frequently necessary owing to the fact that mixed species of wood are used, and this results in the rate of carbonisation fluctuating considerably throughout the kiln.

At the end of the third day, or when the kiln is reduced to half its height, it is considered that the burning is complete.

Holes are then made in the top in order to allow the covering of earth to fall in.

On the (early) morning of the fourth day the outside wall of stones is gradually removed and the charcoal spread widely over the ground.

Earth is then thrown over the coal which may be still burning, and water sprinkled over the burning pieces of wood which have not been completely carbonised—these are termed "Kolangis."

Such pieces are at once removed from the charcoal to prevent the hot coal from igniting. This operation of emptying the kiln lasts usually about four hours, and when the coal is cool, it is collected and put into bags—the smaller pieces and powder being disposed of through a 1" mesh sieve.

In view of the prescriptions of this particular Working Plan—restricting charcoal operations to the more inaccessible coupes of the valley Blocks—it will be at once seen that the question of

reducing to the absolute minimum the amount of water used is of the utmost importance. The quantity of water now considered to be sufficient in the preparation of one kiln of charcoal amounts to approximately six pints, it may therefore be assumed that this minimum has been attained.

This large reduction in the quantity of water used has been effected mainly by allowing the kiln to cool over night, opening it up in the early hours of the morning.

The charcoal prepared by this method is, on the whole, of sufficiently good quality to answer, within reasonable limits, most of the prescribed tests (*i.e.*, having a metallic blue sheen, lustrous across a transverse section and giving a metallic sound when two pieces are clinked together). These qualities are most noticeable in the charcoal prepared from Anjani and Ain species.

E. S. B. TAVENER, I.F.S.,
Divisional Forest Officer,
Satara.

18th March 1926.

REVIEWS.

AN ELEMENTARY MANUAL ON INDIAN WOOD TECHNOLOGY.

BY DR. H. P. BROWN, PH.D. OBTAINABLE FROM GOVERNMENT OF INDIA, CENTRAL PUBLICATION BRANCH, CALCUTTA. PRICE RS. 4.

This book which embodies some of the work done by Dr. H. P. Brown when he was Officer-in-Charge, Wood Technology Section in the Forest Research Institute is a very valuable contribution to the literature on the technology of Indian Woods. Although a great deal of work has been done on the systemisation and silviculture of Indian trees, the study of the anatomy of their timber has been comparatively neglected. Gamble's treatise on Indian Timbers deals only with the gross structure of the species described, and on account of the range of species described is precluded from entering into the details of their microscopic anatomy. The proper use of timber is as much the concern of the Forest Officer as its production; and as Dr. Brown observes "The proper utilization of Indian woods is contingent on a correct interpretation of their technical properties and many of the last in turn are traceable directly to varying anatomical structure."

Dr. Brown has made an attempt in his book to develop his theme from first principles. The first four parts of the book are devoted to a brief description of the classification of plants, the cell, and cell aggregates or tissues. He fears that he may be accused of being unduly didactic and justifies the inclusion of these subjects on the ground that the book is meant for students undergoing preparatory training in forest schools. The inevitable result of condensing so many subjects in the brief space of

forty pages is to make their discussion somewhat sketchy. The general reader will probably find that the approach to the main theme of the book so far from being unduly elaborate is perhaps a little too abrupt.

Dr. Brown is not concerned with the physiology of plants in this book. The general phenomena of plant metabolism (photo synthesis, respiration, etc.) have not been described, as having no immediate bearing on the technology of timber. Starting with the cell as the unit of structure, the author describes in detail its division, and the specialisation it undergoes, from a thin-walled cambial mother-cell with protoplasmic contents into the various tissues (vessels, tracheids, fibres, parenchyma, etc.) that go to form wood. These earlier pages of the book afford a glimpse of the stately march of plants from the lowest non-vascular forms such as algæ, fungi and bacteria, to the highly specialised spermatophytes of woody habit which now form the forests of the world.

The manner in which the various forms of plant life have solved the problems of food, the hostility of their environment, and the perpetuation of their kind, accounts for the structural differences which distinguish them from one another. The author gives a comparative table of the elements of chir *(Pinus longifolia)* and teak *(Tectona grandis)* showing the different ways in which these trees have adapted the structure of their timber to their needs. The former belongs to an ancient woody group of plants, the Gymnosperms, which flourished in an earlier day and now are dying out. These plants bear their seeds in an exposed position, have no vessels and have developed a special type of leaf which serves also the storage function. Teak on the other hand belongs to a group of more highly specialised plants, the Angiosperms, dominant to-day, with flowers often having a showy perianth, and the ovules enclosed in an ovary. They have developed vessels which appear on the cross section of the wood as minute pores and their storage function is served by parenchymatous tissue.

To be able to identify timbers, it is necessary to have an accurate microscopic knowledge of the size, the shape and the

presence or absence of the tissues that make up wood, such as vessels, tracheids, tyloses (ingrowths into vascular tissue due to the enlargement of the pit membrane) fibres, parenchyma, wood-rays and resin-canals. It is however not convenient and not always possible to use a microscope for this purpose. Dr. Brown has given a key for the identification of some sixty timbers based on microscopic features such as can be made out with the naked eye or with a lens.

The identification of timbers is however but one of the uses to which a knowledge of the anatomy of wood can be put. The arrangement and nature of the elements in the minute structure of timber determine not only its appearance but also its strength, its durability and its aptitude for seasoning. Many examples, of which the following are a few, of the interpretation of wood structure in terms of strength, durability, etc., are to be found in the book. As Dr. Brown points out the process of lignification is often confused with that of heartwood formation. The last growth ring in the sapwood is as well lignified as it will ever be and the formation of heartwood is due to the infiltration of organic acids, etc., and colouring matter derived probably by oxidative processes. It follows therefore that sapwood, being as lignified as heartwood, should also be just as strong when the moisture content in both is the same. This inference is borne out by actual test results. Timber in which spiral reversal of the fibres takes place every three or four years, resulting in interlocked grain, as in padauk, *Pterocarpus Marsupium*, and *Shorea robusta*, are difficult to work and are very tough, and their use is indicated for purposes where the timber is subject to sudden shocks (gun carriage poles, wheel spokes, etc.). Timbers like *Xylia dolabriformis* and *Mesua ferrea* derive their great strength from the occurrence of libriform fibres (long thickwalled fibres) in their structure. In members of the Legume and Anacardium families, the fibres tend to be gelatinous on account of arrested lignification. These timbers give up their moisture slowly and crack and split very little during seasoning. The structure of wood has an important bearing on its durability. A well tylosed wood is naturally durable, as the free movement of moisture and air is impeded by the obstructions in

the lumen of the vessels. The presence of essential oils in the cells of the wood renders it very durable, as in the case of teak and deodar. The degree of tylosis varies in different woods. In timbers like *Bischofia javanica* and *Lagerstrœmia* the vessels are almost choked up with tyloses. These species when creosoted under pressure are found to be very resistant to the penetration of the preservative, the absorption being very small and confined to the surface. The Dipterocarps on the other hand treat well on account of sparse tyloses. These examples are enough to illustrate the importance of a knowledge of wood structure as a guide to the mechanical and physical properties of the timber.

The book is copiously illustrated with diagrams, and sixteen full page microphotographs of various timbers are also appended for reference. The student will probably find the language a little too technical, but a glossary of the more difficult terms has been included for his convenience. A few trifling typographical errors have escaped correction but these do not detract from the great value of the work which should be in the hands of everyone who has anything to do with the utilization of timber.

C. R. RANGANATHAN, *I.F.S.*

STATISTICAL METHODS IN FOREST INVESTIGATIVE WORK.

Bulletin 77, Forestry Branch, Department of the Interior, Canada, by W. G. Wright, 1925.

This 32 page bulletin has been written with the object of encouraging the use of statistical methods in forestry practice, in the sense of applying accepted mathematical principles to the

working up of the numerical data collected in the course of forest investigations. It is doubted whether this object will be attained to any appreciable degree, as although the author in developing his subject exemplifies it stage by stage from actual forestry data, mainly form factor measurements, his message appears likely only to reach the mathematically inclined—the already converted. Thus an investigator who thinks that he perhaps ought to be giving probable errors*, etc., when publishing investigations involving measurements, will only learn from this bulletin how he can do so, but nowhere *why* he should,—we venture to think that under the circumstances the latter is much more important. Again, one of the first sections deals with the three common forms of average, the arithmetic mean, the mode and the median: we are told what they are and how to obtain them, but are told nothing about their respective merits. Further, the impression obtained by the non-initiated when perusing discussions involving probable errors, etc., is generally that they must involve a lot of laborious calculation, and this leads to a query as to whether the benefit, if any, is commensurate with the labour; this query is not clearly answered.

However the bulletin may be read with profit by those engaged in carrying out statistical investigations into forestry problems as the mathematics involve nothing more abstruse than a square root (though a good many of the formulæ given must be taken on trust unless reference is made to the standard works quoted), and a new and useful light may be thrown on such matters as the number of samples required to give a maximum error, the rejection of exceptional figures, and the correlation of factors.

The title of the portion on the theory of sampling suggests and that correctly, that it may be of interest in its application to sample trees and sample plots. It is not difficult to realise that if a number of sample sets of figures be collected from a given material, the averages and the probable errors of the same will differ from one another, and these differences require study

* 'Probable error' is defined as a figure such that the chance is even that any given error will exceed it, and similarly fall short of it.

in the same way as the corresponding figures for the individuals of which the samples themselves are composed. Thus in the example worked out for form factors, the "standard deviation" of all the trees of all plots is $\pm 3{\cdot}9$ units, whilst calculated for the means of the 20 plots instead, the figure, now termed "standard error," is $\pm 1{\cdot}3$ and could have been obtained directly by the application of the formula :—Standard error equals standard deviation divided by the square root of number of observations.

In applying these mathematical expressions, standard deviation and standard error, to the individual figure, it is deduced that the *probable* error is two-thirds the standard deviation and the chance of any error exceeding 3 or 4 times the probable error is 1 in 21 and 1 in 126 respectively. The chance of obtaining a divergent figure is thus greater the more numerous the observations, and the limits of rejection recommended are 4 times the probable error for up to 25 observations, and 5 times for more than 25. It is to be noted that the limit of precision in each stage of a work should be the same: the number of observations required to make a sample correct within a given maximum error of the true mean, can be calculated from the range of variation of one set of measurements.

In using these methods, one is warned against various limitations, but these are mostly fairly evident and readily met : they are of course useless when the errors of observation exceed the errors due to selection of samples and they will not reveal persistently biassed selection. It may be accepted that if the difference between two samples reaches 3 times the standard deviation of the difference, the difference is 'significant,' and not due to the sampling though the converse may not be true : this test can be used in connection with such problems as the mortality of seedlings or rate of growth under two sets of conditions.

This leads on to the question of the numerical expression of correlation between two variables, from pairs of observations, showing the value of one factor existing with a given value of another. This problem is rather more complicated, but the calculations may be useful in some cases. Having deduced the

correlation factor with its standard error, one can work out the probable error in calculating one factor from any given value of the other.

In conclusion it may be repeated that the bulletin brings together and exemplifies the mathematical theory of simple sampling, co-efficients of correlation and probable errors in a summary likely to be useful to the mathematically inclined, but unlikely to persuade others that they ought in future to work up all their numerical data in the ways demonstrated.

H. G. C.

EXTRACTS.

A DEMONSTRATION MATCH FACTORY IN BIHAR AND ORISSA.

The Government of Bihar and Orissa have just established a demonstration match factory in the old saw mill of the Opium Factory at Gulzarbagh, on the outskirts of the Patna city. The object of the factory are to see whether good matches can be made in India from Indian woods at a profit in a well-equipped factory; to enable persons to see the best match machinery in action; to enable Government to give advice with confidence to persons who require it; and, lastly, to train any person who desires to learn how to make matches in an up-to-date manner.

The factory will obtain its supplies of wood from the forests of Bettiah and Ramnagar estates. The project was based on the supply of wood at the factory at fifteen annas a cubic foot, but the Bettiah estate has undertaken to deliver 10,000 cubic feet at the factory for ten annas a cubic foot. The factory is equipped with the most modern machines and implements from Sweden. The project was accepted by the Legislative Council last year and Rs. 85,000 have been provided for the scheme. Of this sum Rs. 15,000 represent the working capital and the balance the cost for machinery and plant, erection charges, and preliminaries and contingencies,

The history of the match industry during the last four or five years has not been encouraging, and would-be promoters of match factories have been faced with numerous difficulties. The match industry on scientific and technical lines is still in its infancy so far as Indian manufacturers are concerned, and pioneer work is to be undertaken by Government. The industrialist still needs advice on the type of machinery, the utilization of trained men to undertake the manufacture of matches, and the method of making match-heads to stand the very trying climate in India. A number of persons have started small factories in various parts of India but most are in difficulties and many have had to cease manufacture. They bought unsuitable machines which have either not given the desired production or have been unable to make damp-proof matches. Some of these factories, however, can turn out fair matches, and even now put them on the market at a price to compete with the Japanese article, but they cannot turn them out in sufficient numbers to make their venture pay.

The prospects of establishing the industry are now much better, in the first place the import duty of Re. 1-8-0 per gross is a protection. In addition to this, there are now available a number of young men who have had some training in applied chemistry, mechanical engineering, etc. The Province requires about 1,200,000 gross of boxes of matches a year. In order to be self-contained in the matter of supply it needs forty factories with 100 gross production per day and 300 working days in the year. The forests of the Province have just enough wood to meet this production. Match factories for such production would involve a capital of about Rs. 20 lakhs.—[*Capital.*]

EMPIRE WOOD IMPORTS.

It is regrettable that Empire woods make a poor contribution to our annual supply of timber. But they are of sufficient bulk to justify specific entry in the official statistics, which do not differentiate Empire from foreign timber in many cases, writes a correspondent in the *Times Trade Supplement.*

In the sawn wood section, *i.e.*, wood for the housebuilder and for general purposes, out of a total import of 4,618,549 loads of

the value of £22,500,000, Canada, with a meagre 334,731 loads of 50 cubic feet (spruce and pine) of the value of £2,106,452, is the only Empire country specified. Taking the next most important item, sawn hardwoods (*i.e.*, oak, ash, teak, walnut, etc., in planks and boards) it is found that out of a total import of 24,750,000 cubic feet, valued at over £6,000,000, only the British East Indies, credited with 1,500,000 cubic feet, valued at £720,881, and Canada, about 4,250,000 cubic feet, valued at £675,000, are specifically mentioned. In hewn hardwood—that is, timber in the log—the total imported for the period under review was about 4,125,000 cubic feet, valued at £797,154. Of these logs the British East Indies sent 66,000 cubic feet, value £37,860, and Canada 593,849 cubic feet, valued at just over £140,000. In hewn softwoods, Canada is the only Empire representative named, with 13,559 loads, valued at £160,115, out of a total of 442,000 loads, valued at £1,807,930.

Mahogany.—In the mahogany section the countries of origin are not given, but it is known that fair amounts of that wood come from parts of the British Empire, greatly supplementing the considerable quantities shipped from Central America and the West Indies. In planed wood for flooring the imports of Empire woods are evidently too meagre to be classified. This is also the case with pitwood imports, which from January to November have cost the country, c. i. f., £4,295,841.

Imports from British Possessions overseas are included under the heading of Other Countries, but the import of timbers of the Empire are large and important enough to be specially classified. In the statistics in the Board of Trade returns, the jarrah and karri of Australia, the kauri of New Zealand, the greenheart of British Guiana, the beautiful and so much prized mahogany of British Honduras, the mahogany of British West Africa, the teak and cedar of British North Borneo and pitwood from Newfoundland, are lost sight of altogether, yet all have a place on the British market. Besides teak and rosewood from British India, many other new woods from that vast region are being consumed in the United Kingdom—mahogany, white mahogany, padauk, pyinkado, gurjun, silver greywood, etc. If the Empire wood producing

countries were classified in the monthly returns they would not seem so unimportant as they appear at present, amid the records of such large supplies from foreign countries.—[*The Timber News.*]

FOREST DEVELOPMENT IN THE ANDAMAN ISLANDS.

Some reference must also be made to forest development. There are some 2,200 sq. miles of virgin forest in the Islands, two-thirds of which, or an area of over 1,400 sq. miles, is estimated to be capable of profitable working. The existing supply of mature timber of species which can be at present marketed at a profit is calculated to be about 10 tons per acre or 8,960,000 tons in all, while the annual sustained yield could be as much as 100,000 tons The bulk of this timber consists of five principal species, namely, padauk (*Pterocarpus dalbergioides*), gurjan (*Dipterocarpus* spp.), dhup (*Canarium euphyllum*), badam (*Terminalia procera*), and papita (*Sterculia campanulata*). In addition to these main species lesser quantities of such hardwoods as white chuglam (*Terminalia bialata*), koko (*Albizzia Lebbek*), pyinma (*Lagerstrœmia hypoleuca*), black chuglam (*Terminalia Manii*), and of such soft woods as didu (*Bombax insigne*), thitpok (*Tetrameles nudiflora*) and lettok (*Sterculia alata*) will be available. The configuration of the country is exceptionally favourable both for the extraction and the shipment of timbers. The Forest Department at present employs about 1,000 labourers in its two divisions in the North and South Andamans and operates two saw-mills. During the past five years the average volume of timber exported has been only 6,000 tons per annum, though it rose to over 8,500 tons last year, of which 1,850 tons were sent to Europe, and a further considerable increase is expected in the present year. The existing plant is capable of an outturn of some 20,000 tons per annum but it is obvious that even when such an outturn is attained, the scope for development, given favourable market conditions, will still remain very large.—[*Gazette of India.*]

THE RAIPUR FOREST TRAMWAY.

This interesting "logging railway" in the Central Provinces, which is being pushed through under numerous difficulties, suffered another misfortune on the 8th March through a cyclone or tornado which caused enormous damage to the buildings in progress at Kurend Junction, and inflicted great hardships on the staff and workmen whose tents and temporary shelters were first blown flat and then drowned out by the torrential rain which followed.—[*Indian Engineering.*]

NOVEL TIMBER-STACKING MACHINE.

No less than 180 tons of British steelwork has been recently employed for the construction of a machine for stacking timber to be used in the wood-pulp mills of the Newfoundland Power and Paper Co. The length of the structure is 250 ft., and the height to the end of the conveyor 130 ft.—the concrete ballast weighing 200 tons. Up the centre of the jib runs a conveyor travelling at 2½ miles per hour. Hence, when working at full capacity, the machine has an hourly output equivalent to a continuous trunk of wood 9 in. in diameter and 2½ miles long. Manufactured by the Armstrong Construction Co., 51, Victoria Street, Westminster, London, S.W.1, at their works in Germiston, Glasgow, the steelwork upon completion was shipped to Newfoundland and erected on the site by the manufacturer's own staff, with the aid of a temporary crane improvised on the spot from spare materials at hand. The work of assembly occupied only ten days.—[*Timber Trades Journal.*]

THE MYSORE WOOD DISTILLATION PLANT.

AN ENTERPRISING SCHEME.

As the ambitious Mysore scheme known as the Bhadravati Iron Works, was dependent on fuel for the smelting processes, it was clear from the beginning that a necessary adjunct of the foundry was a wood distillation plant. Up to the present this is the only plant of its kind that has been erected in India, and

there has been considerable difficulty in adapting the methods and machinery used in the West to the difficult conditions of the East. There were few who had any knowledge of conditions in India, and, as a result, some of the machinery imported has proved unsatisfactory. But with the growing experience of the last three or four years, certain modifications have been made possible, and when the time for renewal comes, the authorities will be in a better position to state their requirements to the makers of the plant.

The men engaged to commence the work were not acquainted with Indian conditions, and this made progress slower than it would otherwise have been. Indian men have now been trained in practically all departments of the work, and it is believed that a sufficient number will be forthcoming to staff every branch of the smelting furnaces and the wood distillation.

The fuel used in the works comes from the forests of Shimoga and Kadur, and is brought by special tramway lines laid down by the Government. These forests are very extensive, but the demands of the works are great, and unless steps are taken to carry out a large scheme of afforestation, the fuel supply will be one of great seriousness. Attention, however, is being given to the question. Compared with the variety and quality of timber used in America, the Mysore forests produce a very poor type, and large quantities have to be rejected as unfit for the plant. Here again, experience will teach what types of wood produce the best charcoal and give the best returns in by-products. The fact that it requires about four tons of wood to make the charcoal required for the production of one ton of pig-iron gives an idea of the great demand the works will make on the forest supply. The distillation plant has been constructed with a capacity for dealing with 240 tons a day, though there will be no difficulty in adapting it to a larger quantity, say 80 to 100 tons more. The logs are cut into smaller pieces, billets about four and a half feet long, in the saw mill erected near the plant, the thicker pieces being halved or quarter cut. When these logs, which are from 12 feet to 16 feet long, are cut ready for use, they are placed in waggons each with a capacity of five tons. These waggons which

are made of iron are pushed into the carbonising retorts, each of which holds 20 tons. These retorts are heated by non-condensible gases, with fresh wood and charcoal as an auxiliary. Here they remain for 24 hours, after which the cars, which are now full of charcoal, are removed to a cooler, where they remain for some 24 hours. As a precaution against any firing they are removed to an open iron shed, where they remain for another full day. The charcoal is now ready for use, and is removed, as required, to the furnaces in which the iron ore is melted.

During the process above briefly described, the by-products have been released from the wood, and arrangements are made for the further treatment of these. The analysis of the various jungle woods used show that they yield the following percentages : 30 per cent. charcoal ; 6 to 7 per cent. tar ; 2·5 per cent. acetic acid ; and 1·3 per cent. wood spirit. The gases formed during the process of distillation are led to condensers, the liquid obtained being crude pyroligneous acid which consists of about 80 per cent. water with varying percentages of acetic acid, methyl alcohol, acetone, tar, oils, etc. This liquor is pumped into storage tanks where the tar separates and settles down. When the tar has settled the clear liquid is passed through an evaporator which consists of three vacuums—0 to 2 inches, 8 to 10 inches, and 25 inches or more respectively. The soluble tar and oils are thus separated, and are ready for disposal in the market. There is usually a good market for these products and there is reason to believe the authorities will find no difficulty in disposing of all they can produce.

After the clear liquid has been neutralised with slaked lime, it is pumped into large vats with cone bottoms, where the sludge settles. The neutralised liquid is pumped to an overhead feed tank, and while under continuous pressure, supplies the alcohol which is drawn off at the top and runs through a cooler into a collecting tank. The neutral oil left may be used for the manufacture of creosote. The acetate liquor, freed from alcohol, is passed to a cast-iron triple effect evaporator, from which it flows into a pressure tank, from which it is fed by compressed air to overhead concentrated acetate liquor tanks

and then to motor-driven drum dryers. The acetate, completely dried by these processes, is broken into small pieces, and is then carried to bins ready for putting into sacks for export.

The wood alcohol produced is available for many purposes but it is largely used in making de-natured alcohol and formalin. After getting the glacial acetic acid the weak acetic acid liquor is usually neutralised with different bases of as lime, copper and lead. Copper acetate is used largely in drying the grey acetate of lime, which, when distilled, yields the valuable product " acetone," one of the chief chemicals used in the manufacture of cordite. Since the work began there has been steady progress in the wood distillation department, but it is not always easy to find a ready market in India for the by-products. Many years will pass before the work will be able to pay any dividend to the Government of Mysore, but it speaks well for the enterprise of the State that such a scheme should have been undertaken. Experience will teach improved methods suited to the country, and as it is seen there is good prospect of financial success, private firms will undertake subsidiary work.—[*Indian Engineering.*]

FOREST RESEARCH IN INDIA

GOVERNMENT'S PLANS.

(From our own Correspondent.)

Delhi, 10th March.

Mr. J. W. Bhore, the Secretary of the Department of Education, Health and Lands, announced in the Legislative Assembly to-day that the Government had completed a scheme for developing their Dehra Dun Forest Research Institute and Forestry Classes into a centre of instruction in the science of tropical forestry second to none in the world.

He paid a high tribute to the magnificent work already done by the Indian Forest Service, whose work would make the courses of the new institution unique in excellence. It was intended that the standards of instruction and examination should

be regarded as the hallmark of forest science. It was hoped to open the courses in November.

Mr. Bhore estimated that the initial capital expenditure would be equivalent to less than £15,000, and said that the re-organization of the existing institutions would mean practically no increase in yearly expenditure. The classes would be open not only to students from British India and the Indian States, but to private students, and he hoped they would gather them from all over the world. The fees would amount to Rs. 2,400 (£180) per annum, including accommodation, lighting and water.

The Government, said Mr. Bhore, would shortly issue full particulars of the scheme, which would show that the training was going to be equal to that given in any forestry school in Europe.—[*The Times.*]

FIGHT BETWEEN WILD ELEPHANTS.

(From our own Correspondent.)

Jamshedpur, 15*th March.*

AN ALL-NIGHT BATTLE.

The death of two unusually big wild elephants is reported from Rakha Mines, about 20 miles from Jamshedpur, under extraordinary circumstances. The origin of the fight is unknown but it seems they commenced fighting some time during the day on a hill near by.

The surroundings were resounded by their shouts. Eventually they came down the hills and the fight took a frightful turn after dusk when they reached within the locality of the residential quarters for the employees of the Copper Mines which are situated there. So far as could be gathered, the tuskers fell upon each other and made awful noise. Men fled as best they could and others took shelter in their houses, but under great fear that any time the animals might crush them along with their houses. The fight continued the whole night just opposite the hospital,

Tusks missing.

In the morning people thought both the animals had fled to the jungles and on their coming out they saw to their great surprise a big tusker lying dead besmeared with blood in a small ditch of water and mud with wounds, bruises, and smashed head. What struck people was that it had both its tusks broken and the broken parts were missing and this, the people suspected must have been done by some clever fellow at night who had been watching the fight from some place, and thus made some fortune. A number of aborigines came with axes and other weapons to take away the tusks, tail and skin of certain parts of the body. But the disappearance of the tusks disappointed them all. The intervention of several people also made them not to part with its other parts of the body.

It is believed that dying elephants drag themselves into water or lean themselves against some rocks, and it is not known whether it was in accordance with this practice that the animal at last found its way into the pool before its death or driven therein under compulsion by its opponent.

The groanings or rather the angry roaring of the other elephant was heard in the morning in the neighbouring jungles and people were very careful not to approach that side. Information reached next day that that animal also was found dead in the jungle about 10 miles off, and the most surprising part of it was that it had four tusks. Besides its own two, portions of other two were found driven deep by the side of the inner bone of its eye and by the side of the trunk.

Wild elephants.

The presence of wild elephants is not a very uncommon feature in these parts and this has been witnessed several times in and about Ghatsila, a health resort, a few miles off from Rakha. There, herds of elephants visit paddy fields coming down from the hills where tigers also are plentiful. On a few occasions one or two young elephants were found loitering near about the fields in the early morning, evidently in search of the herd which had

already left before dawn. On one occasion a big dead elephant was found leaning against a hillock, as if standing, about 10 miles off from Ghatsila. Wild elephants abound in the hills southward from Jamshedpur, and in the Dalma hills northward where tigers also do abound, but never before a case was heard of such a fight as the present one which brought about the death of two huge tuskers.—[*Amrit Bazar Patrika.*]

HIMALAYAN SURVEY.

The council of the Royal Geographical Society have recently purchased a *photo-theodolite* which has been constructed by Mr. H. Wild. It has been designed for use in Major Mason's survey expedition in the Himalayas. At the monthly meeting of the Royal Geographical Society Mr. Hinks, the Secretary, and Major Hutchinson of the Ordnance Survey, gave a detailed explanation of the instrument to a company of experts. It is a combination of theodolite and camera, and the need for such an instrument was experienced by the Mount Everest expedition. It has been made specially accurate and refined for purposes of stereo photographic survey, and it consists of a Wild theodolite mounted above a camera upon a tripod. At present it is the only instrument of its kind. After it has served the purposes of Major Mason's survey it will be returned, the *Daily Telegraph* states, to the Geographical Society for further use as required.—[*Indian Engineering.*]

THE TIMBERS OF BURMA AND INDIA.

SIR,—Mr. A. L. Howard, in the paper recently read by him before the Oxford University Forest Society, is reported to have stated that "unless a man has a commercial training it cannot be expected that he can understand commerce." Judging from his paper, I should say that the converse holds good, and that is, that unless a man has had a forest training he cannot be expected to understand forest administration.

Mr. Howard has been harping vaguely on what he now refers to as "those marvellous stores of wonderful timbers" in Burma and India, but he has not yet told us what precisely these marvellous timbers are, nor where exactly the wonderful stores of them exist.

A forest well-nigh denuded of all its best species, as most of the accessible unclassed forests in Burma are, argues the local recognition of their value. Mr. Howard claims to have some knowledge of the forests of Burma, but his lectures make me wonder if he is really capable of distinguishing a padauk tree from a pyinkado, or a teak tree from an eng.

Mr. Howard has selected five matters in connection with the duties of a forest officer and then attempts to show wherein the forest officer fails in a grasp of these matters. I take them in the order given and comment as briefly as I can on what he has to say :—

1. *What to Plant.*

Because a carefully nursed mahogany tree happened to have been grown in a botanical garden in Calcutta it does not follow that this species would do equally well grown on a large scale as a forest crop: and surely the professional man's opinion on the subject is worthy of acceptance? Then, again, with such "marvellous stores of wonderful timbers" already available, why trouble about introducing exotics?

Mr. Howard must surely have misunderstood his "well-informed and highly conscientious forest officer" who could not understand the necessity of planting teak. When I left Burma, the Forest Department was raising taungya teak plantations as fast as ever the labour available would permit, and to suggest that teak is not planted is quite incorrect.

But there are other ways of increasing teak regeneration than by plantations, and, apparently, Mr. Howard has never heard of such a thing as improvement fellings. There are, perhaps, forest officers who differ in their views on the comparative merits of planting and improvement fellings, a question on which the silviculturist alone is competent to argue, and one on which it is futile for the commercial man to dogmatise.

2. *On what terms leases should be granted ; and*

3. *On what terms contracts for the sale of timber should be made.*

I would remind Mr. Howard that the forest is a quasi commercial department, with, at its head, officers of 25 to 30 years' experience behind it, and for him to say that they do not know how to draw up a contract is, well——absurd.

A comparison is made between the rates of royalty paid on timber to Government and the prices secured by shippers. These shippers are, of course, the large European firms who have leased forests from the Government, and I would suggest that, before attempting to draw any comparisons, Mr. Howard should ascertain what it costs the firms to bring their timber from remote forests to the shipping ports. It must be remembered that they maintain large staffs of well paid European assistants, that they are great employers of native labour, and own herds of dragging elephants, which cost Rs. 10,000 or more per head for a good animal, and that the casualties amongst these beasts are often heavy. The Forest Department selects, marks, and girdles trees in the leased areas, but the cost of felling, logging and extraction is borne by the lessees.

Mr. Howard has obviously based his figures on the very small percentage of logs of a firm's outturn that are shipped to Europe. These logs are carefully selected, and are of the best quality. If Mr. Howard has been over any commercial firm's depôts in Burma he must have seen there thousands of logs which are of such poor quality as hardly to be worth the cost of extraction.

Then, again, has not the commercially-minded Mr. Howard been comparing the prices of converted timber with the rates of royalty paid on it in the log ?

4. *The Best Manner to Find the Best Market.*

There is what is known as a Utilization Branch of the Forest Department, which deals with this matter. Mr. Howard, apparently, cannot be convinced of the utility of scientific research work in connection with the lesser-known timbers, and clamours

or what he terms "commercial methods." Well, surely the Forest Department has not been remiss in this direction, for did it not employ Mr. Howard to find a market for its timbers?

5. *The Nomenclature of Timbers.*

This is a difficult problem, but if the commercial man will persist in misnaming timbers and changing the name of the Burmese "Eng" (more correctly "In") to Eng teak, can the forest officer be blamed?

"WOODLANDER."

7th January 1926. (*Timber Trades Journal.*)

TREES THEIR OWN PROTECTORS.

The Botanical Department of the University of Leeds has made a series of investigations to learn how trees protect themselves, against disease when branches have been broken or cut off. Prof. J. H. Priestley, the Professor of Botany there says that the living tissue divides to form new cells, which in time cover the exposed surface, this process taking months, and in large branches many years. The spores of disease organisms may settle on the wound, germinate in a few days, and then are able to penetrate into the healthy tissues of the tree with fatal results. Such an organism is responsible for the disease known as "silver leaf," which enters by cuts or wounds in even small twigs and causes severe damage to valuable fruit and timber trees.

Branches were cut from trees of different varieties during each month of the year for the purpose of the investigation, and the cut ends of the trees examined monthly for at least a year. This meant the microscopical examination of at least 144 specimens, and actually many more were examined. It was found that a month after the cut had been made the sap pipes near the cut surface gradually became plugged and blocked by a substance known as wound gum. This wound gum appears first in the living cells which surround the pipes, and then in the pipes themselves, and is assumed to be a product of the starch which these live cells contain, for this starch disappears from the neighbourhood of the cut surface at the time the plugs form in the pipes.

The chief practical importance of this work lies in the observation that the block occurs quickly or slowly, or not at all, according to the time of year in which the cut is made. In May and the early part of summer, there is a rapid plugging of the pipes; during late summer and autumn this takes place much more slowly, while if the cut is made in the winter there is no attempt to form a block until the sap begins to rise again in the spring. In late spring and early summer the block occurs so soon after the cut is made that disease organisms have no chance to enter. This danger is made possible later in the year, while during the winter it would appear that the tree opposes very little resistance. These facts may be of importance in relation to pruning, for they indicate when the practice may be followed most favourably.—[*The Timber Trades Journal*.]

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FIRE PROTECTION IN PLANTATIONS.

It is now some years since the question of fire protection in Burma was discussed in the *Indian Forester* and although some of our friends in India were doubtless as little interested by the discussion as we in Burma were by lengthy articles on the Spike Disease of *Santalum album* I venture to reopen the question in a mild form.

Heaven forbid that I should ever suggest that fire protection ought to be reintroduced wholesale as in earlier days, but I think that its abandonment has gone too far. Fire is liable to produce a good deal of heat—on one occasion I am told prot. and antagonists came to blows over it—and the obstinacy of those in favour of fire protection probably caused its opponents to go further than they would otherwise have done.

There were two main arguments against fire protection. The first was, and is, that its cost for ordinary mixed deciduous forest is out of all proportion to the advantage gained owing to the relatively poor stocking of valuable species, the second, that fire protection when carried out over long periods prevents the regeneration of teak which is the most, and over large areas the only valuable species in the forests. Both arguments are absolutely sound when applied to the ordinary mixed deciduous forests of Burma, but they are not sound when applied to plantations, firstly because the value of the crop is considerable and out of all proportion to the cost incurred on fire protection, and secondly because no regeneration of teak is required in plantations at any rate until they are nearing maturity.

About four years ago my attention was drawn to the harm being done in certain 20 to 30 year old plantations in a particular division by fire and soil erosion, and fire protection was reintroduced with very beneficial results, though I believe it was later again abandoned. Since then I have had an opportunity of seeing large numbers of plantations in other divisions and I am still more certain that fire protection is necessary. We are now planting quite a number of species other than teak, and, though their requirements as regards protection are not fully known in all cases, I take it that most people will agree that the probability is that fire will do harm, and that, therefore, these plantations should be protected until experiment has shown that this is unnecessary.

Cutch may be taken as an example of a species which benefits by fire, at least so far as an experiment in the Zigon Division goes. The tree can apparently stand a fairly hot fire without the slightest damage even from the start of the plantation, but the fire undoubtedly damages and kills back the young creepers which spring up and which cannot be cut at a reasonable cost in a cutch plantation owing to the thorny branches of the tree.

The ability of a species to stand a fire is not, however, the only consideration ; the direct or indirect effects of fire in a particular locality on the particular soil under that species is also a matter of great importance.

As most of our older plantations are of teak we are more particularly concerned with the effects of fire on this species. The tree itself is fire hardy from a comparatively early age and, though one often sees damage at the base of the stem due to fire, it can as a rule be disregarded, though it is still open to question whether the prevention of this in a plantation would not be worth while as it is very liable to spread up the bole if fires are repeated constantly and the exposed dead timber is not infrequently burnt. It is however the effect of fire on the soil under the teak which I think really objectionable.

A teak tree has a large and stiff leaf which is capable of holding up a very considerable quantity of water before becoming so bent down that the water is able to run off and there is little doubt in my mind that the mechanical effect of

the drip is very harmful. Anyone who has had the misfortune to camp in the rains in a rest house surrounded by teak trees will realise that the drip from teak must have considerable mechanical effect. It is also noticeable that under pure teak the undergrowth is, unless it is bamboo, generally poor and scanty, partly I think, due to drip but also to the considerable calorific value of the fallen teak leaves. An absence of undergrowth means that there is nothing to break the force of the drip before it reaches the ground. Some teak plantations are on flat ground, some on steep hill sides, others on sandy soil and others again on stiff soil. On flat moist areas near streams where the fires are not fierce the damage by soil erosion is absent or small mainly because there is usually an undergrowth of some sort but on hill sides the erosion is very marked.

There is an endless chain of damage in teak plantations connected with drip, soil erosion and fire. First the fires reduce the not too luxuriant undergrowth thus exposing the soil, then the drip and rain water erode the soil and expose the tree roots, the next year's fires further reduce the undergrowth and damage the exposed roots until finally the stage is reached where the soil is practically bare, the roots of nearly every tree have been exposed and fire has killed them. There are already numerous cases of this sort and it should be remembered that the fire protection of teak plantations has not been abandoned very long and it may be expected that the damage will become still more evident in a few years' time.

Some of the older plantations are already well on their way to maturity and the question of regeneration will eventually arise. It may, of course, be possible to replant successfully soil which has been exposed for years to fire, the hot weather sun and to erosion but it is at any rate doubtful. On the other hand we know that we can replant land which has produced a dense crop of trees and an undergrowth of bamboos, etc., and it therefore seems reasonable to take steps to see that the conditions of natural forest are reproduced as closely as possible and the only way of doing this cheaply seems to be the encouragement of undergrowth by fire protection. Owing to the artificial

introduction of a complete canopy many of the light-demanding and fire-resistant species which would naturally form the understory are checked but by introducing fire protection we can replace them by increasing the number of non-fire-hardy shade-bearers.

There is no doubt that under the more enlightened system of thinnings now being introduced the undergrowth will have a better chance but the canopy will still be fairly dense and too much reliance should not be placed on this alteration in our methods of treatment of plantations.

There is a rather Irish system of fire protection which has its adherents, under which the forest is burnt early in the season. I have only one reason for believing that this is not a pernicious doctrine and that is that I have entirely failed to find any area in which it had done anything but harm. There is, therefore, no exception to prove the rule.

There may be some theoretical support for the system but there seems to be a good deal more against it if it is desired to protect forest growth from damage by fire.

Natural fires take place when the fire hardy species are dormant and by burning the forest early in the year one exposes them to fire before they are ready for it when the sap is still rising. Theoretically the result in the case of young plants is that the sap is heated and bursts the vessels and though possibly the damage may not be apparent externally it is in reality far greater by reason of its being internal. It is urged that the fires under the early burning system are not "hot." This, in cases where this extremely difficult operation is carried out as it is intended, is true but the fire is *slow.* *Many people will pass* a finger through a hot flame rapidly but only a fool would hold his finger in the flame of even a candle for any length of time.

One can argue theoretically for hours or pages without result but practical examples must carry weight. Recently I have seen two particularly good examples of the results of early burning, one in an old teak plantation which had suffered under this operation, I believe, for five years and the other in a young plantation which has been burnt (fortunately only on a small experimental

area) for three years. In both cases the ground is practically bare of all small growth; considerable erosion has taken place, roots are exposed and have been killed by fire and there is hardly a tree which has escaped damage.

Early burning is undoubtedly a most efficient method of removing all undergrowth from an area and keeping it bare and for this reason it is eminently unsuitable for use in teak plantations.

The above refers to teak; other species may require different treatment. Cutch for example has very small leaflets which will tend to break the force of the rain and there will be no additional mechanical damage to the undergrowth or soil. The tree gives a less heavy shade than teak so that again the undergrowth has a better chance and owing to the small size of the leaflets there is not much to burn if a fire occurs. It is probable that in this case fire protection is unnecessary.

Each species must be considered on its own merits.

Working as we do over large areas it is not always possible to provide the ideal treatment, nor would it be possible to protect isolated plantations, but I certainly consider that where there are large areas of teak plantations fire protection should be introduced as the rule, only to be abandoned for special reasons for each area. It is not improbable that once an undergrowth has been firmly established, it may be considered possible or even desirable to abandon protection for a time but it should be reintroduced at once if the undergrowth begins to die off.

There is only one suitable treatment for the advocates of early burning in teak plantations and that is to burn them—the earlier the better.

G. S. SHIRLEY, I.F.S

ADVANCE GROWTH.

The following article has been suggested by a publication of the Yale University School of Forestry entitled "The Treatment of Advance Growth arising as a result of Thinnings and

Shelterwood Cuttings," by Louis J. Leffelman and Professor C. Hawley.

The treatment of advance growth is undoubtedly important, in that in all cases where the uniform system is practised the question arises whether old, previously existing reproduction or 'advance growth' should be allowed to remain, be eradicated or coppiced. In India the question is, perhaps, even more important than in temperate countries owing to the prevalence of species which have the characteristic of 'dying back' in youth. In the case of the *sal* this dying back and the consequent formation of clumps of *sal* "switches" arising from a swollen and frequently ancient root stock is famous, and the regeneration of *sal* forests is almost entirely dependent upon the presence of such advance growth at the time of the regeneration fellings, true seedling regeneration being practically unknown. It will be interesting, therefore, to see how far regeneration from 'advance growth' is sound or unsound, with particular reference to the methods employed now in the regeneration of *sal* torests.

A necessary preliminary to this subject is the definition of the various growth forms that are encountered in advance growth. The terms suggested below are not claimed to be original being based on those given in the above quoted bulletin of the Yale School of Forestry.

'Advance Growth.' This term may be taken to denote all tree growth that makes its appearance before the main final fellings, thus distinguishing the seedlings that are a result of such fellings from previously existing growth.

A "coppice shoot" is a tree which has grown from a stump more than 2" basal diameter, the shoot originating at a height of less than 1' 0" from the ground.

A "seedling" is a tree grown directly and uninterruptedly from seed.

A "seedling shoot" is a tree grown from a stump less than 2" basal diameter and at a height less than 1' 0" from the ground. A "sedling shoot" may have one or more stems, when it may be called a "single" or "multiple" seedling shoot respectively. Such seedling shoots are formed by one or more supplementary

shoots consequent to the death or injury of the original leader, as in the case of a *sal* seedling which "dies back."

A "pollard" is a tree whose stem (or stems) has originated at a height of more than 1′ 0″ from the ground subsequent to the death or ill-health of the original leader. A pollard may be either a 'single' or 'multiple' pollard. This definition is meant to cover the growth form found so commonly in *sal* forests, when the leading shoot, being broken or unhealthy owing to suppression, is replaced by a new leader.

A "root sucker" is a shoot from a root. But shoots from the collar or immediately below the collar should be taken to be coppice shoots.

All these growth forms except root suckers are common in *sal* advance growth, and obviously it is necessary to know which is the best form of regeneration. This question will be discussed from four points of view, namely, vigour, soundness and straightness of the resulting tree and also the quality of the timber produced.

Firstly with regard to vigour, and in this connection persistence of vigour is in many ways of more importance than the initial rate of growth, which, however, is also important. The initial height growth (and admittedly height growth is an excellent criterion of the vigour of a tree) is greatest in coppice shoots, less in single and multiple seedling shoots and least in seedlings, the difference between single seedling shoots and coppice shoots being small, while pollard shoots behave very similarly to coppice shoots. The question then arises whether these relative degrees of vigour remain constant throughout life, or whether, as is believed generally, the seedling remains vigorous longer, eventually equalling and then surpassing the other growth forms, finally producing the larger tree. In the publication to which reference has been made above, the conclusion is drawn that as far as height growth is concerned, the growth varies until ultimately seedlings, seedling shoots and coppice shoots attain equal heights, whereafter their height growths remain similar. This conclusion was reached after the measurement of variously aged stands up to an age of 40 years.

Hence there was no conclusion possible as to the behaviour of trees over 40 years old. The impression in Europe is that eventually coppice shoots lose their vigour and fall behind seedling trees, although there are instances of fine hardwood stands which have originated as coppice. As far as *sal* forests are concerned there would appear to be little fear that coppice shoots from small stools will be inferior to seedling trees. Seeing the universal prevalence of *sal* advance growth with thickened root stocks and the capability of such advance growth to take advantage of openings in the overhead cover, coupled with the very great rarity or even complete absence of natural seedlings which grow straight up, it is hard to believe that the type of regeneration was very different in the past before forest conservancy commenced. On this assumption, therefore, all the existing *sal* forests, with perhaps a rare exception here and there, have originated from coppice, either as seedling shoots, true coppice shoots or pollards.

Consequently it would seem probable that, unless the coppice shoot originates from a large stump or from a stump that has been coppiced once or twice previously, there is little to choose between the ultimate average rate of growth of the various growth forms. From this point of view there can be no objection, therefore, to regenerating by cutting back advance growth. In fact such coppice and seedling shoots have a decided advantage over seedling regeneration in that, without being handicapped by a decrease in eventual size and by having a fast initial rate of growth, they are much safer from suppression by heavy weed growth.

Secondly there is the question of soundness. Decay can only enter through a wound or through the junction between a dead member and the living plant. Consequently a growth form which has no wound, or one whose wound heals rapidly, is exposed much less to incipient unsoundness than those whose wounds are slow in healing. Therefore a seedling will be the freest from rot and a coppice shoot or pollard the most sensitive. This is due not only to the history of the stem but to the method of root formation. In the case of coppice shoots, especially from

large stumps, although an almost entirely independent root system is formed, there is a clear avenue for the entry of decay at the junction between the new and old, now dying root stock. With seedling shoots, however, the old root stock is absorbed entirely by the new tree and there is no dangerous join. Hence, as long as the old root stock is not decayed, there is no more danger of rot entering a seedling shoot through the root than in the case of a true seedling tree.

In many *sal* forests there is a considerable amount of unsoundness, and as these forests have undoubtedly arisen in the great majority of cases from advance growth, at first sight it might seem very dangerous to rely on advance growth for their regeneration now. A closer examination is, however, reassuring. In the past restocking of the forests must have taken place by means of pollard shoots that arose from advance growth standing in a state of suppression under a more or less dense canopy. On the canopy becoming opened this advance growth shot ahead by means of a new leading shoot, originating below the old leader which slowly died off, a likely entry point for rot thus being formed. Those trees which originated from seedling shoots, after the burning and dying back of the original stem, would be freer from decay than these pollards. An exception to this would be where frequent and continued dying back took place owing to recurrent frost or unsuitable soil conditions resulting in a decayed, abnormal root stock. But it is reasonable to suppose that much of the hollowness and unsoundness of mature *sal* trees is due to their origin as seedling shoots from switchy advance growth. Consequently the process of cutting back advance growth for regeneration purposes is to be recommended in that pollards are eliminated thereby and seedling shoots encouraged. An additional conclusion is that where seedling shoots are abundant coppice shoots from large stems should be discouraged by favouring the former in cleanings.

Thirdly as to straightness, and under this head can be considered general shape of the crown. This latter point is in youth as well as later on of considerable importance, since old suppressed advance growth among some species has a distinct

tendency to become bushy and spreading to the great detriment of surrounding regeneration. Straightness of the bole is not affected by the type of growth form except near the base (or higher in the case of some pollards), but the swollen or curved bases which, in addition, frequently show hollows originating from the old decayed leader of a pollard, are such common sights in many *sal* forests that pollards and coppice shoots from large stumps are considered with disfavour at once. Here again, therefore, is an argument in favour of cutting back (in spite of the loss of a year or two's growth) and also of eliminating coppice shoots from old stumps in clearings.

Lastly arises the question of the quality of timber. For this purpose seedlings should be contrasted with the remaining growth forms, since the rates of growth of these latter are approximately the same but are different from that of the seedling trees. Unfortunately little is known on this subject, but it is contended by some that the timber of any coppice type of growth is inferior to that of a seedling owing to its more rapid and perhaps excessively rapid growth. Except for the growth of the first few years this is hard to believe as after a certain age the vigour of the various growth forms becomes similar. Moreover, as has been pointed out above, in the case of *sal* true seedling forests must be very rare, so that all *sal* timber must be from a coppice formation. Hence there should be little danger of the timber obtained from cut back advance growth being inferior in quality.

In summing up, therefore, it would seem that seedling trees are the most valuable form of reproduction closely followed by seedling shoots, while pollards and coppice shoots are the least valuable. But, particularly in India where weed growth is often such a danger, this conclusion must be modified in favour of seedling shoots owing to their rapid initial growth which enables them to compete with weeds. Consequently there would seem to be little objection to the method frequently employed in the *sal* forests of the U. P., namely cutting back and burning advance growth, in that rapid initial growth is encouraged while there is little to fear from subsequent loss of vigour or decay. In fact it would seem advisable to avoid trying to obtain seedling regen-

eration, and to rely entirely on advance growth for the regeneration of *sal*. The problem in such a case would be to encourage the advent of reproduction well before a given area comes into P. B. I, even 20 or 30 years before would not seem excessive, as *sal* reproduction appears capable of existing for an almost unlimited time under these conditions and yet be able to shoot ahead when cut back and given complete overhead light. Admittedly it may be just as difficult to obtain regeneration at this time as at any other, but anyhow there will be a longer period in which to work, and if it can be done (and perhaps annual burning of the leaf layer will prove to be of the utmost value in this respect) *sal* regeneration fellings will prove to be a delight instead of an anxiety.

F. C. OSMASTON, I.F.S.

TRAMETES PINI ON DEODAR IN THE BASPA VALLEY, BUSHAHR STATE, PUNJAB.

Trametes pini is now a well-known pest of our blue pine forests. A sporophore of it on a deodar tree was first noticed in 1910 by the late Pandit Gokal Dass, Extra Deputy Conservator, in the Kalala reserve of Simla Forest Division. Shortly afterwards, Mr. H. M. Glover recorded an isolated instance of the same fungus occurring on *chir* (*Pinus longifolia*) in Kulu. These were considered as single occurrences and it was still believed that in Indian coniferous forests, *Trametes pini* was confined o the blue pine and that the deodar and *chir* pine forests were, to all intents and purposes, immune from attack by this pest. Several individual diseased *chir* pine trees have since been noticed in forests of Seraj (Kulu) and elsewhere, but no serious attack of the fungus in any of the *chir* pine forests has yet been reported. The case, however, is different with deodar. The Lolab Valley (Kashmir) deodar forests are already badly infected with *Trametes pini*. The pest has now appeared in the deodar forests of the Baspa Valley (Bushahr) and it will be no wonder if after a careful examination of these forests, it is discovered that the attack of the fungus on deodar in this valley, is as bad as that in the Lolab!

In the course of my inspection of the Baspa Valley forests for sample plot work last year, in the first week of June I came across one or two isolated trees of deodar bearing small sporophores of *Trametes pini*. They did not particularly attract my notice, but on the last day of my stay at Sangla, when laying out a sample plot in Bassering I, 29 (*b*), one deodar tree of medium size, apparently well grown and healthy, standing in the midst of a well stocked pure deodar crop, compelled more attention. It was literally covered with sporophores: about 8 of them could be counted round the trunk at about breast height and some more were visible higher up. They were, as usual, in the form of "irregular brackets, situated close to the stubs of dead, broken or cut branches," but not so prominent as they generally are on blue pine. Two small longitudinal sections of the wood bearing sporophores were cut out and these are now placed in the Botanical museum at Dehra Dun. Plate 7 shows *Trametes pini* on deodar in the Baspa Valley.

It is very unfortunate that for want of time I could not study the extent to which the infection had spread to other trees. Isolated diseased trees are, however, known to be always dangerous as centres of infection, and the absence of the sporophores which are the only outward sign of the disease, on the adjoining trees, does not necessarily mean that they are not already attacked. Sporophores develop about 5 – 15 years after actual infection and usually after the damage caused by the parasite is well marked. It is, therefore, possible that the areas with isolated trees bearing sporophores are already badly infected with the disease.

Bassering I, 29 (*b*) stands on an alluvial, gravelly flat between two streams, cut up and bordered by cultivation of the neighbouring village. The wooded area is nearly pure deodar of which not a few are old malformed branchy trees which are the likely source of infection. Blue pine which is mostly young and apparently sound, forms only about 5 per cent. of the total crop in the whole of Bassering block, and this generally occurs on the upper limits of the forests. The appearance of sporophores on odd deodar trees in the midst of an almost pure deodar crop is rather serious. It is now certain that *Trametes pini* can

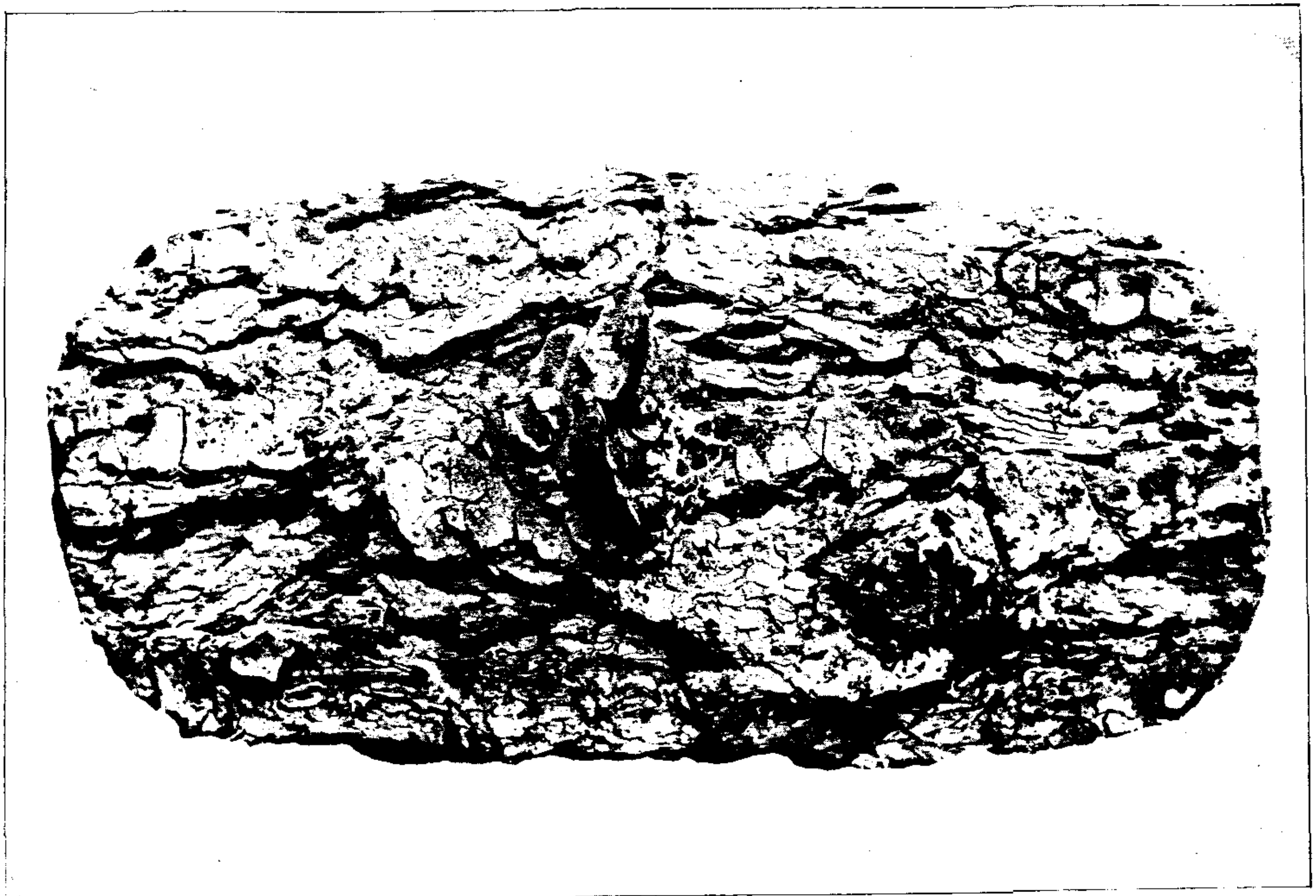

Photo I. N. Sharma September 1925.

Trametes pini on deodar.

exist in the absence of blue pine and that it readily attacks deodar (though probably on account of its oily heart wood, not to the same extent as it does the blue pine). It is, therefore, essential to adopt special control and preventive measures against the disease, before it assumes a virulent form in the locality, and the following steps are suggested for adoption.

The first thing to do is to examine carefully the whole of the deodar block and to locate the isolated trees bearing sporophores. The working plan of these forests is shortly to be revised and the preliminary inspection for allotment to Periodic Blocks might be commenced now and while it is being done, the degree to which these forests are infected with this parasite could be determined. All infected trees, if their number is not large, and all over-mature malformed branchy trees which are the veritable centres of infection of both *Trametes* and *Peridermium*, and which have so long escaped the forester's axe, would be felled and quickly removed. The stumps and the refuse including sporophores would have to be burnt completely. It is also suggested that it should be a part of the regular duties of Forest Guards to remove all sporophores, wherever and whenever found, and to burn them. The infected trees are not saved thereby but the dissemination of the disease is checked.

Deodar has always been a royal tree and its freedom from the virulent attack of this fungus in the past has in my opinion been due to the special protection against lopping and other mal-treatment, afforded to it under the law. It is probable that to check effectively the inroads of the fungus from diseased blue pine forests into healthy deodar areas, prohibition of lopping of all conifers, in the demarcated or undemarcated, reserved or protected, State owned or private forests, and cultivated or barren waste lands, without any of the existing exceptions, would have to be enforced. The practice of pruning the side branches of conifers now appears unwise and should be stopped.

It would be better to fell *Peridermium*—infected deodar trees rather than lop or prune away diseased parts. And if for any reason wounds are produced in forest trees, the wound surface

should be protected with wood tar, or better still with coal tar. A thick coating with white lead paint is also sometimes used.

In this connection, it would be interesting to know if the abundant new crop of deodar which came up naturally under the badly lopped and entirely diseased blue pine forests in Riachathach, etc., of Outer Seraj (Kulu) and where a large number of diseased blue pine trees were removed under improvement fellings in 1915-16 and after, is virtually free from the infection of *Trametes pini* or not. The new crop of blue pine in a regeneration area with diseased blue pine mother trees is known to be infected (Traijhakar of Outer Seraj) and it should cause no surprise if deodar regeneration in similar areas is also found to be diseased!

There is another question which probably does not have a direct bearing on the subject, but an early investigation into which is very desirable. "Shakes" in the sawn deodar timber of Upper Bushahr are common. These are probably only radial shakes and may be due to poverty of soil, bad season of felling or some other unknown factor, and I do not suggest that they are positively due to any weakening caused in the wood by this or any other fungus. But the following extract from Mr. Sher Singh's article on "*Trametes pini* on deodar" which appeared in the *Indian Forester* of July 1924, may be of help to the local Forest Officers in this investigation :—

"The effect of this fungus on deodar is a little different from that on *kail*. While in the latter case the core of a tree may be more or less completely rotten, in the case of deodar, mycelia of the fungus search out and penetrate one ring only. This ring is the ring of weakness and during conversion logs or sleepers give tway along this ring appearing very much like a "cup shake." The attacked portion first turns turmeric yellow, but turns dark brown later on. In more acute cases of attack, several rings may be so attacked, or pockets of wood may be delignified and destroyed, the deodar wood becoming useless as timber."

PARMA NAND SURI.

LIST OF TRADE NAMES FOR INDIAN TIMBERS.

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NOTE.

In the following list no timbers belonging to different genera have been given the same trade name, with the exception of the Burmese species *Pentacme suavis* and *Shorea obtusa* whose timbers are virtually indistinguishable, and by local usage are considered equally useful.

Closely similar timbers belonging to the same genus have been grouped under the same trade name where there is no sufficient industrial difference in their use to justify allotting a separate name to each species.

The list has been arranged in two parts giving in alphabetical order (1) the scientific and corresponding trade names and (2) the trade and corresponding scientific names.

PART I.

Abies Pindrow ...	... Himalayan Silver Fir.
Acacia arabica ...	... Babul.
Acacia Catechu ...	... Cutch.
Acer spp. ...	... Himalayan Maple.
Acrocarpus fraxinifolius	... Mundani.
Adina cordifolia ...	... Haldu.
Aesculus spp. ...	... Indian Horse Chestnut.
Albizzia Lebbek ...	... Kokko.
Albizzia odoratissima	... Black Siris.
Albizzia procera ...	... White Siris.
Alnus spp. ...	.. Indian Alder.
Alstonia scholaris ...	... Chatiyan.
Amoora spp. ...	... Amoora.
Anogeissus acuminata	... Yon.
Anogeissus latifolia	... Axlewood.
Anthocephalus Cadamba	... Kadam.
Aquilaria Agallocha	... Indian Eagle wood.
Artocarpus Chaplasha	... Chaplash.

Artocarpus hirsuta	Aini.
Artocarpus Lakoocha	Lakuch.
Azadirachta indica	Neem.
Beilschmiedia sikkimensis	Tarsing.
Berrya Ammonilla	Trincomalee wood.
Betula spp.	Indian Birch.
Bischofia javanica	Bishop wood.
Bombax insigne	Didu.
Bombax malabaricum	Semul.
Boswellia serrata	Salai.
Bucklandia populnea	Pipli.
Buxus sempervirens	Box-wood
Calophyllum spp.	Poon.
Canarium euphyllum *Canarium strictum*	Black Dhup or Indian White Mahogany.
Carallia lucida	Carallia.
Carapa moluccensis	Pussur.
Careya arborea	Kumbi.
Cassia Fistula	Indian Laburnum.
Castanopsis Hystrix	Katus.
Castanopsis spp.	Indian Chestnut.
Cedrela spp.	Toon.
Cedrus Deodara	Deodar.
Celtis australis	Nettle wood.
Chickrassia tabularis	Chickrassy.
Chloroxylon Swietenia	Satinwood.
Cinnamomum spp.	Cinnamon.
Cordia fragrantissima	Sandawa.
Cordia Macleodii	Hadang.
Corylus spp.	Indian Hazel.
Cullenia excelsa	Karani.
Cupressus torulosa	Himalayan Cypress.
Dalbergia cultrata	Burma Blackwood, Indian Cocobolo.
Dalbergia latifolia	Bombay Blackwood, or Indian Rosewood.
Dalbergia Oliveri	Tamalan, or Burma Tulipwood.

Dalbergia Sissoo ...	...	Sissoo.
Dichopsis elliptica ...	...	Pali.
Dichopsis polyantha	...	Tali.
Dillenia pentagyna...	...	Dillenia.
Diospyros spp. ...	...	Ebony.
Dipterocarpus alatus	...	Gurjun.
Dipterocarpus costatus	...	
Dipterocarpus Griffithii	...	
Dipterocarpus incanus	...	
Dipterocarpus indicus	...	
Dipterocarpus pilosus	...	Hollong.
Dipterocarpus tuberculatus	...	In, or Eng.
Dipterocarpus turbinatus	...	Gurjun.
Duabanga sonneratioides	...	Lampati.
Dysoxylum glandulosum	...	White Cedar.
Dysoxylum malabaricum	...	
Elæodendron glaucum	...	Alan.
Eriolæna Candollei	...	Salmon wood.
Eugenia spp. ...	...	Jaman.
Fragræ fragrans ...	...	Anan, Burma yellowheart.
Fraxinus floribunda	...	Himalayan Ash.
Garcinia spp. ...	...	Gamboge wood.
Gardenia latifolia ...	...	Indian Boxwood.
Garuga pinnata ...	...	Garuga.
Gluta tavoyana ...	...	Burma Gluta.
Gluta travancorica...	...	Indian Gluta.
Gmelina arborea ...	...	Gumhar.
Grewia tiliæfolia ...	...	Dhaman.
Hardwickia binata...	...	Anjan.
Hardwickia pinnata	...	Piney.
Heritiera spp. ...	...	Sundri.
Holoptelea integrifolia	...	Indian Elm.
Homalium tomentosum	...	Burma Lancewood.
Hopea odorata ...	...	Thingan.
Hopea parviflora ...	...	Hopea.
Hymenodictyon excelsum	...	Kuthan.
Juglans regia ...	...	Walnut.

Juniperus macropoda	...	Indian Juniper.
Lagerstrœmia Flos-Reginæ	...	Jarul, Pyinma.
Largerstrœmia hypoleuca	...	Andaman Pyinma.
Lagerstrœmia lanceolata	...	Benteak, Nana.
Lagerstrœmia parviflora	...	Lendia.
Lagerstrœmia tomentosa	...	Leza.
Lophopetalum Wightianum	...	Banati.
Machilus spp. ...	...	Machilus.
Magnolia spp. ...	...	Magnolia.
Mangifera spp. ...	...	Mango.
Melanorrhœa usitata	...	Thitsi.
Melia Azedarach ...	...	Persian Lilac.
Mesua ferrea ...	...	Mesua.
Michelia Champaca	...	Champak.
Millettia pendula ...	...	Thinwin.
Mimusops Elengi ...	...	Bullet-wood.
Mimusops littoralis...	...	
Morus spp. ...	...	Mulberry.
Odina Wodier ...	...	Wodier.
Olea ferruginea ...	...	Olive.
Ougeinia dalbergioides	...	Sandan.
Parashorea stellata...	...	Tavoy wood.
Parishia insignis ...	...	Parishia.
Pentace burmanica ...	...	Thitka, Burma Mahogany.
Pentacme suavis ...	...	Burma Sal.
Picea Morinda ...	...	Himalayan Spruce.
Pinus excelsa ...	...	Blue Pine.
Pinus longifolia ...	...	Chir, Chil.
Planchonia andamanica	...	Red Bombway.
Podocarpus spp. ...	...	Thitmin.
Populus spp. ...	...	Indian Poplar.
Protium serratum (Bursera serrata) ...	...	Indian Red Pear.
Pterocarpus dalbergioides	...	Andaman Padauk.
Pterocarpus macrocarpus	...	Burma Padauk.
Pterocarpus Marsupium	...	Bijasal.
Pterocarpus santalinus	...	Red Sanders.

Sageræa elliptica ...	... Andaman Bow-wood.
Salix spp. ...	... Indian Willow.
Santalum album ...	... Sandal wood.
Sachima Wallichii...	... Needle wood.
Schleichera trijuga...	... Kusum.
Shorea obtusa ...	... Burma Sal.
Shorea robusta ...	... Sal.
Soymida febrifuga ...	... Soymida.
Stephegyne diversifolia	... Binga.
Stephegyne parvifolia	... Kaim.
Stereospermum spp.	... Padri, Padal.
Taxus baccata ...	.. Yew.
Tectona grandis ...	... Teak.
Terminalia bialata ...	... White Chuglam, Indian Silver greywood.
Terminalia Chebula	... Myrabolam.
Terminalia Manii ...	... Black Chuglam.
Terminalia myriocarpa	... Panisaj.
Terminalia paniculata	... Kindal.
Terminalia procera	... Badam.
Terminalia tomentosa	... Laurel.
Tetrameles nudiflora	... Thitpok.
Vateria indica ..	... White Dhup.
Vatica lanceæfolia ...	... } Mascal.
Vatica Scaphula ...	... }
Vitex altissima ...	... Milla.
Vitex glabrata ...	... Yoma wood.
Xylia dolabriformis	... Pyinkado.
Xylia xylocarpa ...	... *Irul.*

PART II.

Aini	... *Artocarpus hirsuta.*
Alan	... *Elæodendron glaucum.*
Amoora ...	... *Amoora spp.*
Anan, Burma Yellowheart	... *Fragræa fragrans.*
Andaman Bow-wood	... *Sageræa elliptica.*

Andaman Padauk... ...	*Pterocarpus dalbergioides.*
Andaman Pyinma... ...	*Lagerstrœmia hypoleuca.*
Anjan	*Hardwickia binata.*
Axlewood	*Anogeissus latifolia.*
Babul	*Acacia arabica.*
Badam...	*Terminalia procera.*
Banati	*Lophopetalum Wightianum.*
Benteak, Nana	*Lagerstrœmia lanceolata.*
Bijasal...	*Pterocarpus Marsupium.*
Binga	*Stephegyne diversifolia.*
Bishop wood	*Bischofia javanica.*
Black Chuglam	*Terminalia Manii.*
Black Dhup, Indian White Mahogany	*Canarium euphyllum, Canarium strictum.*
Black Siris	*Albizzia odoratissima.*
Blue Pine	*Pinus excelsa.*
Bombay Blackwood, Indian Rosewood ...	*Dalbergia latifolia.*
Boxwood	*Buxus sempervirens.*
Bullet-wood	*Mimusops Elengi.* *Mimusops littoralis.*
Burma Blackwood, Indian Cocobolo	*Dalbergia cultrata.*
Burma Gluta ...	*Gluta tavoyana.*
Burma Lancewood... ...	*Homalium tomentosum.*
Burma Mahogany, Thitka ...	*Pentace burmanica.*
Burma Padauk	*Pterocarpus macrocarpus.*
Burma Sal	*Pentacme suavis.*
Burma Sal	*Shorea obtusa.*
Burma Tulipwood, Tamalan .	*Dalbergia Oliveri.*
Burma Yellowheart, Anan	*Fragrœa fragrans.*
Carallia	*Carallia lucida.*
Champak	*Michelia Champaca.*
Chaplash	*Artocarpus Chaplasha.*
Chatiyan	*Alstonia scholaris.*
Chickrassy	*Chickrassia tabularis.*

Chil	...	... *Pinus longifolia.*
Chir	...	...
Cinnamon	...	... *Cinnamomum spp.*
Cutch	...	... *Acacia Catechu.*
Deodar	...	... *Cedrus Deodara.*
Dhaman	...	.. *Grewia tiliæfolia.*
Didu	...	... *Bombax insigne.*
Dillenia	...	... *Dillenia pentagyna.*
Ebony	...	... *Diospyros spp.*
Eng, In	...	... *Dipterocarpus tuberculatus.*
Gamboge wood	...	... *Garcinia spp.*
Garuga	...	... *Garuga pinnata.*
Gumhar	...	... *Gmelina arborea.*
Gurjun	...	... *Dipterocarpus alatus.* *Dipterocarpus costatus.* *Dipterocarpus Griffithii.* *Dipterocarpus incanus.* *Dipterocarpus indicus.* *Dipterocarpus turbinatus.*
Hadang	...	... *Cordia Macleodii.*
Haldu	...	... *Adina cordifolia.*
Himalayan Ash	...	... *Fraxinus floribunda.*
Himalayan Cypress		... *Cupressus torulosa.*
Himalayan Maple	...	... *Acer spp.*
Himalayan Silver Fir		... *Abies Pindrow.*
Himalayan Spruce	...	... *Picea Morinda.*
Hollong	...	... *Dipterocarpus pilosus.*
Hopea	...	... *Hopea parviflora.*
In, Eng	...	... *Dipterocarpus tuberculatus.*
Indian Alder	...	... *Alnus spp.*
Indian Birch	...	... *Betula spp.*
Indian Boxwood	...	... *Gardenia latifolia.*
Indian Chestnut	...	... *Castanopsis spp.*
Indian Cocobolo	...	... *Dalbergia cultrata.*
Indian Eaglewood	...	... *Aquilaria Agallocha.*
Indian Elm	...	... *Holoptelea integrifolia.*
Indian Gluta	...	... *Gluta travancorica.*

Indian Hazel	*Corylus spp.*
Indian Horse Chestnut ...	*Aesculus spp.*
Indian Juniper	*Juniperus macropoda.*
Indian Laburnum	*Cassia Fistula.*
Indian Poplar	*Populus spp.*
Indian Red Pear	*Protium serratum Syn. Bursera serrata.*
Indian Rosewood, Bombay Blackwood	*Dalbergia latifolia.*
Indian Silver greywood, White Chuglam	*Terminalia bialata.*
Indian White Mahogany, Black Dhup	*Canarium euphyllum.* *Canarium strictum.*
Indian Willow	*Salix spp.*
Irul	*Xylia xylocarpa.*
Jaman	*Eugenia spp.*
Jarul, Pyinma	*Lagerstrœmia Flos-Reginæ.*
Kadam	*Anthocephalus Cadamba.*
Kaim	*Stephegyne parvifolia.*
Karani	*Cullenia excelsa.*
Katus	*Castanopsis Hystrix.*
Kindal	*Terminalia paniculata.*
Kokko	*Albizzia Lebbek.*
Kumbi	*Careya arborea.*
Kusum	*Schleichera trijuga.*
Kuthan	*Hymenodictyon excelsum.*
Lakuch	*Artocarpus Lakoocha.*
Lampati	*Duabanga sonneratioides.*
Laurel	*Terminalia tomentosa.*
Lendia	*Lagerstrœmia parviflora.*
Leza	*Lagerstrœmia tomentosa.*
Machilus	*Machilus spp.*
Magnolia	*Magnolia spp.*
Mango	*Mangifera spp.*
Mascal	*Vatica lanceæfolia.* *Vatica Scaphula.*
Mesua	*Mesua ferrea.*

Milla	... ...	*Vitex altissima.*
Mulberry	... ..	*Morus spp.*
Mundani	... ...	*Acrocarpus fraxinifolius.*
Myrabolam	... ...	*Terminalia Chebula.*
Nana, Benteak	... ...	*Lagerstrœmia lanceolata.*
Needle wood	... ...	*Schima Wallichii.*
Neem	... ...	*Azadirachta indica.*
Nettle wood	... ...	*Celtis australis.*
Olive	... ...	*Olea ferruginea.*
Padal, Padri	... ...	*Stereospermum spp.*
Padri, Padal	... ...	*Stereospermum spp.*
Pali	... ...	*Dichopsis elliptica.*
Panisaj	... ...	*Terminalia myriocarpa.*
Parishia	... ..	*Parishia insignis.*
Persian Lilac	... ...	*Melia Azedarach.*
Piney	... ...	*Hardwickia pinnata.*
Pipli	... ...	*Bucklandia populnea.*
Poon	... ...	*Calophyllum spp.*
Pussur	... ...	*Carapa moluccensis.*
Pyinkado	... ...	*Xylia dolabriformis.*
Pyinma, Jarul	. ..	*Lagerstrœmia Flos-Reginæ.*
Red Bombway	... .	*Planchonia andamanica.*
Red Sanders	... ...	*Pterocarpus santalinus.*
Sal	... ...	*Shorea robusta.*
Salai	... ...	*Boswellia serrata.*
Salmon wood	. ...	*Eriolæna Candollei.*
Sandal wood	... ...	*Santalum album.*
Sandan	... ...	*Ougeinia dalbergioides.*
Sandawa	... ...	*Cordia fragrantissima.*
Satinwood	... ...	*Chloroxylon Swietenia.*
Semul	... ...	*Bombax malabaricum*
Sissoo	... ...	*Dalbergia Sissoo.*
Soymida	... ...	*Soymida febrifuga.*
Sundri	... ...	*Heritiera spp.*
Tali	... ...	*Dichopsis polyantha.*
Tamalan, Burma Tulipwood	...	*Dalbergia Oliveri.*
Tarsing	... ...	*Beilschmiedia sikkimensis.*

Tavoy wood ...	... *Parashorea stellata.*
Teak ...	... *Tectona grandis.*
Thingan ...	... *Hopea odorata.*
Thinwin ...	... *Millettia pendula.*
Thitka, Burma Mahogany	... *Pentace burmanica.*
Thitmin ...	... *Podocarpus spp.*
Thitpok ...	... *Tetrameles nudiflora.*
Thitsi ...	... *Melanorrhœa usitata.*
Toon ...	... *Cedrela spp.*
Trincomalee wood...	... *Berrya Ammonilla.*
Walnut ...	.. *Juglans regia.*
White Cedar ...	... *Dysoxylum glandulosum.* *Dysoxylum malabaricum.*
White Chuglam, Indian Silver Greywood ...	... *Terminalia bialata.*
White Dhup ...	... *Vateria indica.*
White Siris ...	... *Albizzia procera.*
Wodier ...	... *Odina Wodier.*
Yew ...	... *Taxus baccata.*
Yoma wood ...	... *Vitex glabrata.*
Yon ...	... *Anogeissus acuminata.*

TENTATIVE KEYS TO THE ORDERS AND FAMILIES OF INDIAN INSECTS.

BY T. B. FLETCHER.

Bulletin No. 162, 1925, *Agric, Research Inst., Pusa* (*Rs.* 1-4-0.)

This Bulletin consists of dichotomous keys to four hundred and ninety-five families of insects known to occur in India ; there are nine not very well reproduced plates illustrating many of the characters used in the keys. The author hopes to provide in a future edition illustrations for all characters used. It might be found possible to give many of these illustrations as marginal text-figures in the next edition.

The author in his preface explains the need for these keys "our ideas regarding classification have tended towards the recognition of more minute division into Orders and Families until it has become extremely difficult for any single worker............. to place a general collection of Indian Insects under their appropriate Families, or even Orders."

In one or two cases, groups of insects which seem worthy of family rank have not been separated in these keys; for example there are strong reasons, based both on larval and adult characters, for separating Melasidæ from Elateridæ.

The keys are based nearly wholly on adult characters, and only occasionally are larval structures used; on page 51 it is stated for the Buprestidæ "larva with anterior 3 or 4 segments much broader than the rest"; although this is generally true, there are exceptions to this, for in certain leaf-mining genera the body has a very different form.

The difficult question of synonymy again arises; we have become accustomed to accept fairly cheerfully the results of the activities of the experts who discover that generic and specific names must be changed; we know for example that our old friend *Duomitus leuconotus* must be called (until further notice!) *Xyleutes persona*, but it does seem rather hard that long used family names must be changed and it is probable that more is lost than is gained by such changes as *Syntomidæ* to *Amatidæ*, *Anthribidæ* to *Platyrrhinidæ* and so on.

It is noticed that many of the family names are given the termination ...... *adæ*; it would seem better to keep to . ... *idæ* as is customary and as is recommended in the Report of the British National Committee on Entomological Nomenclature.

In the next edition a useful addition would be diagrams illustrating the various systems of nomenclature for wing venation; the present-day position, where different systems are used for different orders, is most confusing.

A very useful and much needed work summarising the modern views on classification.

J. C. M. G.

THE EFFECT OF REPEATED FOREST FIRES UPON THE REPRODUCTION OF COMMERCIAL SPECIES IN PETERBOROUGH COUNTY, ONTARIO, BY C. D. HOWE, Ph. D.

This pamphlet is the result of a detailed investigation into the question of forest fires by the author in 1913 over an area of 85,000 acres in the county of Peterborough, Ontario, Canada. The area was originally dominated by red and white pine and most of the old growing stock was felled and removed from the area 25 years ago. All these pine lands have been burnt at least once, and some of them eight times, during the last 50 years and hence these areas were selected for investigation.

The results arrived at are very valuable and deserve the attention of all interested in fire conservancy. It will be instructive, therefore, to place before the readers of the *Indian Forester* a brief summary of the conclusions arrived at by the author.

The whole area was classified according to the number of times the different portions had been burnt and enumerations over sample strips one chain wide, which ran through the entire length of each type, were made of all trees one inch or more in diameter. It was found that one severe burning of an area immediately after lumbering did not seriously interfere with the reproduction of pine. The number of pine trees, 110 per acre, found on such an area is about right for proper development and besides, poplar and other commercial trees, are found in sufficient numbers. In areas burnt twice there are only fourteen pine trees, and six other commercial trees per acre as compared with 110 pine trees and 27 other commercial trees per acre in areas burnt once. Thus the second burning reduced the amount of pine to one-eight of that on areas burnt once, and of other species to one-fifth. In areas burnt thrice there are only seven pine trees per acre and although the percentage ratio of poplar 1" to 2" diameter class to the other diameter is practically the same as on areas burnt twice, the plants in this case are crooked, deformed and already attacked by disease. Other commercial trees like oak, cedar, spruce, etc., are only 18 per acre as compared with 100 per acre in the case of areas burnt once or twice. In areas burnt many times over, which means 5 to 7

severe fires and several ground fires, there are only three pine trees per acre and in all 22 trees per acre as compared with 626 in areas burnt only once.

Basing his calculations on these results, Dr. Howe states that the financial loss in this area due to repeated fires is \$ 3,000,000 for pine and \$ 200,000 for pulpwood. Further the potential value of the existing stand of pine and poplar was worked out and it was found that the existing growth of these species is capable of producing a future value of more than \$ 2,275,000 which it is worth while saving, from a business point of view.

The author very ably concludes his report by emphasising the importance of fire protection and suggests means that are to be employed to gain this end. There are two obvious ways, (1) to have means of guarding against fires and of putting them out before they get out of control and (2) to start a vigorous campaign of education and publicity so that the frequenters of forests may be careful in the use of fire. The second is indeed a hard task and the author lays great emphasis on it and deals with the question in detail in his report.

These investigations over a small area in Canada are well worth the serious consideration of Indian Foresters and the general Indian public. How many of us who calmly witness big forest fires year after year realise the great financial loss these conflagrations mean to the wealth of this country.

Several good illustrations and an instructive map accompany the report.

I. N. SEWAL.

EXTRACTS.

INDIAN FOREST SERVICE TRAINING COLLEGE AT DEHRA DUN.

Simla, the 5th May 1926.

Forests. Resolution No. 436.—The Governor-General in Council with the approval of His Majesty's Secretary of State for India,

has decided to inaugurate from the 1st November 1926 at the Forest Research Institute and College, Dehra Dun, a course of instruction in forestry up to the standard required for the Indian Forest Service. The course of instruction which will begin on the 1st November each year will extend over a period of two years and students qualifying at the end of that term will be awarded a diploma. The training will be supervised by the President of the Forest Research Institute assisted by a Professor of Forestry and a number of Instructors in Forestry and subjects auxiliary to it. It will follow the lines which have proved satisfactory at Cooper's Hill and at the Universities of Oxford, Cambridge and Edinburgh, where probationers for the Indian Forest Service have been trained hitherto. Arrangements will be made to ensure that the training which it is proposed to impart at Dehra Dun will be in no way inferior to that now obtainable at the Forestry Schools in Great Britain.

2. For a career in the Indian Forest Service and for admission to the new advanced course at Dehra Dun a good general education and a substantial knowledge of one of more branches of natural science, with proficiency in mathematics and English, are essential. The Government of India desire that this point should be emphasised for the information of intending candidates.

3. The course will be open to students of the following categories :—

(1) Probationers for the Indian Forest Service who will be selected in accordance with the regulations which will shortly be published.

(2) Students from Indian States and private students desirous of obtaining the Forestry Diploma who have reached a qualifying standard which will be prescribed by the Forest College authorities.

(3) Indian Forest Service or Provincial Forest Service officers deputed by local Governments to undergo the course of training.

(4) Students deputed by Governments of Provinces in which Forests are a transferred subject, preparatory

to their appointments to services in those provinces constituted in substitution of the Indian Forest Service.

(5) Officers in class (3) who are not deputed but are permitted to undergo the course at their own request while on leave.

(6) Private students who have obtained a Provincial Forest Service course certificate.

(7) Students deputed by governments of countries outside India.

4. Fees for the two year course will amount to Rs. 4,800 per student. This will cover cost of tuition, also of lodging, light and water and other services at headquarters for the two years. All other expenses such as cost of messing, books, instruments, clothes, travelling expenses, etc., must be met either by the students themselves or by the authorities who send them for training at the Forest College.—(*Gazette of India, May 8th*, 1926.)

THE NEW FOREST COLLEGE.

The announcement that the Government of India have now definitely decided to inaugurate at the Forest Research Institute and College at Dehra Dun, a course of instruction in Forestry up to the standard required for the Indian Forest Service is of the first importance. It represents a triumph for the first Legislative Assembly which in September 1922 without a division, amended a Government resolution so as to record an opinion that all recruits for the Indian Forest Service should be trained at Dehra Dun in accordance with the recommendations of the Islington Commission. The Government's proposal at that time was that recruitment should be by selection in England and India of recruits who had already undergone a preliminary education in Forestry, followed by training for one year, in England and Europe, of all recruits together at a Central Institution as recommended by the Inter-Departmental Committee on Imperial Forestry Education in their Report of February 1921. The difference between that scheme and the one now adopted is clear.

India is to be completely self-contained in the sphere of forest education. The chief objection to the Assembly's proposal was that of cost. The Government evidently do not intend to let that weigh with them. They emphasise, as they clearly must, that the standards of the new institution must be equal to those obtaining in Great Britain. Dehra Dun thus will become the centre of another remarkable development in the education of Indians and in the efforts made to Indianise the public services. The Lee Commission recommended that the recruitment to the Imperial Forest Service in the Provinces, where forests were reserved, should be on the basis of 25 per cent. European and 75 per cent. Indian. The effect of the new regulations on European recruitment can be properly gauged when full details are received. Meanwhile, it should be noted that the Muddiman Report was not unfavourable to the transfer of the forests in the Provinces.

The valuable asset which India possesses in her vast forests is generally recognised, and Dehra Dun will, therefore, hold in its hands no small part of the destinies of India. Covering a quarter of British India the net profits from the forests of India are estimated to have risen from Rs. 15 lakhs to Rs. 2½ crores in fifty years. This satisfactory result has been achieved by the skill and devotion of a highly-qualified Service. It is consequently of the utmost importance that there should be no relaxation in the standards which have governed the selection of officers in the past. Whether Indians, in sufficiently large numbers, will be found ready to adopt a career in the Forest Service remains to be seen. It has its fascinations and attractions, but its very real disadvantages as well: for example, the long periods of loneliness which so often fall to the lot of the Forest Officer. Yet there should be every ground for enthusiastic acceptance of an opportunity to enter a Service which is so much a part of India and so closely allied to her main industry. For to quote from Mr. Hullah's speech in the Assembly, the forest are "an important source of fodder supply, their influence on climate, on drainage and on conserving the water-supply of our rivers and canals is immense." They also have great commercial

possibilities, for Indian timbers are now world famous for their variety and quality, while other products of the forests are finding a ready market in India and overseas.—[*The Pioneer.*]

INDIAN PUBLIC SERVICES.

Permanent Commission Appointed.

The Secretary of State for India in Council has appointed Mr. Wilberforce Ross Barker to be chairman of the Indian Public Service Commission.

The Commission, which is being appointed in accordance with the provisions of sections 96 *C* of the Government of India Act, will be a permanent body like the Civil Service Commission in this country. Its functions will, as recommended by the Royal Commission on the Superior Civil Services in India, fall into two categories:—

(*i*) The recruitment of *personnel* for the Public Services and the establishment and maintenance of proper standards of qualification for admission to them;

(*ii*) Quasi-judicial functions connected with the disciplinary control and protection of the services.

The establishment of a Public Service Commission for India was provided for by the Government of India Act of 1919, and the creation of such a body may be said to complete the process of giving effect to that reforming measure on all important points.

A year ago Lord Birkenhead intimated in Parliament that the prolonged discussion between Delhi and Whitehall on the subject had shown the difficulties in the way to be enormous. He said that the Commission would be charged on the one hand, with maintaining adequate standards of recruitment in India for the Services, and on the other with protecting the Services, by the establishment of a body of the highest standing to advice the executive Government in regard to the discipline of the Services and their general interests. The Commission is not to have the power to exercise any veto on appeals to the Secretary of State.

The Lee Commission emphasized the paramount importance of securing as members of the Commission men of the highest public standing, and of the possession by two of their number at least of high judicial or other legal qualifications. These standards are well met in the case of the Chairman. He was educated at Marlborough and Worcester College, Oxford, where he gained, in 1899, the Chancellor's English Essay prize. After practising as a barrister, he went to the Board of Education for legal work in 1903. From 1918 to his retirement last year he was legal adviser to the Board. In that capacity he did most valuable service in assisting Mr. Fisher to draft his great Education Act of 1918.

Mr. Barker embarks for India on the s.s. Rawalpindi at Tilbury on April 16th. His appointment, like those of his four colleagues, is for five years. Unlike them, the Chairman is debarred by the rules from eligibility for further service of the Crown in India, though not from reappointment at the end of five years.—[*The Times.*]

The Secretary of State for India in Council has appointed Mr. Arthur Herbert Ley, C.S.I., C.I.E., C.B.E., I.C.S., Secretary to the Government of India in the Department of Industries and Labour; Sir Philip Hortog. Kt., C.I.E., late Vice-Chancellor of Decca University; the Hon. Saiyid Raza Ali, Member of the Council of State; and Diwan Bahadur Sir T. Vijayaraghava Achariyar, K.B.E., Member of the Legislative Assembly, to be the members of the Indian Public Service Commission.—(*The Times.*)

GOVERNMENT OF INDIA TIMBERS.

Messrs. W. W. Howard Bros. & Co., of London and Southampton, announce that at the request of the Government of India they have agreed to continue as sole agents for the sale of Government timber until December 31st, 1926. According to the terms of the notice of resignation handed in by Messrs. W. W. Howard Bros. & Co., the agency should have terminated on June 30th, but in deference to the wishes of the Government the firm will continue to operate as agents until the end of the year.—[*Timber News.*]

FOREST DEMAND.

LEGISLATIVE ASSEMBLY.

March 10th, 1926.

Demand No. 21—Forest.

The Honourable Sir Basil Blackett: Sir, I beg to move:

"That a sum not exceeding Rs. 8,69,000 be granted to the Governor-General in Council to defray the charges which will come in course of payment during the year ending the 31st day of March, 1927, in respect of 'Forest'."

EDUCATION IN FORESTRY, ETC.

Diwan Bahadur T. Rangachariar: Sir, with your permission I should like to move Nos. 40 and 41 on the List to reduce the provision under the sub-head II-BB-1 by Rs. 5 and provision under the sub-head III-B-4.—Supplies and Services, and Contingencies by Rs. 5, because they bear on the same point more or less.

Mr. President: The Honourable Member may move both together.

Diwan Bahadur T. Rangachariar: Sir, I remember very well the discussion last year on the questions which I raised. The first question I should like to have information about is the progress of Indianisation in the Forest Service. We are all aware that under the Lee Commission Report 75 per cent. of new recruits should be Indians. I am obliged to raise this question here under this Department because the Departments do not furnish departmental reports for each year showing the progress of Indianisation which has been effected by each Department. I wish, Sir, that such a wholesome practice were introduced so that along with the Budget we may have a report from each Department showing what developments have taken place under various matters of that kind, and I should like to know what progress has been made since last year, in the last 12 months, in Indianisation both in the services and also in the officers of the Institute referred to at Dehra Dun,—because I attach the greatest importance to Indians being recruited to the

officers' grade in Research Institute at Dehra Dun so that Indians may have the opportunity of acquiring technical and scientific knowledge which I find very valuable in that Institute. The other matter I wish to know about is as regards the scheme for the new college which we find provided for under capital expenditure on extending the building or rather renovating the building and converting it for the purpose of training probationers. I may at once inform the Honourable Member, Mr. Bhore, that I have seen the proceedings of the Standing Finance Committee of the 11th February, 1926, where references are made to this scheme. I see that provision is made there for training 12 officers or 12 students as probationers in that Institute per annum. That includes not only the provincial services but also the men for the States also, and the accommodation, it is stated, in the college will be for about 24 students; and I see also some calculation made of the average annual cost of each student; it comes to about Rs. 3,000 I think for each student per annum. I want to know whether it is proposed to give scholarships to enable persons who cannot afford that payment; whether it is in the mind of the Government of India to offer scholarships to deserving probationers is a matter also which I should like to know. I also want to know whether the College will be open only to people who have already been entertained as probationers or it will also be open to people who seek to enter that service at their own cost and whether there are any limitations as to admission by provinces, whether particular numbers are reserved for particular provinces, and all those things. I should like to have fuller particulars of that scheme. There is one other matter which I consider of the greatest importance: I should like to know when this institution will begin to function for the purposes intended, and whether adequate provision will be made in this college for training in all the branches of the subjects they have to learn for performing their duties. Sir, it is with these purposes in view that I have made these proposals. Sir, I move the motions standing in my name.

Mr. J. W. Bhore (Secretary, Department of Education, Health and Lands): Sir, I had hoped that the record of this

Department would be quite sufficient to prevent any charge being levelled against it of indifference to the progress of Indianisation. Ever since the Lee Commission's proposals saw the light of day we have both in the spirit and in the letter endeavoured to keep to its recommendations in regard to recruitment. Since 1924, of the 23 officers recruited to the Indian Forest Service—I exclude for the moment Bombay and Burma who are masters in their own house—16 have been Indians and 7 have been Europeans. That, Sir, I think, ought to be sufficient to convince the Honourable Member that in the matter of Indianisation we are proceeding along the lines laid down by the Lee Commission. We cannot of course get the numbers each year exactly in the proportion laid down. We shall have to level up to the percentages recommended by the Lee Commission over a period of years. Then, Sir, I come to the more restricted question of the appointment of Indians to the staff at Dehra Dun. The House will realise that opportunities for Indianisation in a strictly limited staff must of necessity be also limited, but I do contend that we have definitely kept before us this goal of Indianisation, subject to two conditions. Those conditions are these, firstly we must maintain unimpaired the standards of our work which we cannot allow to deteriorate, and secondly, we can be no party to treating inequitably or overlooking the just claims of non-Indian officers of the Indian Forest Service. Knowing the House as I do, I feel absolutely certain that these qualifications of the general rule will be accepted by the House. I may say that the number of Indians in the superior controlling staff of the Institute has increased, and I think I can best show the progress of Indianisation by taking the vacancies the permanent vacancies which have occurred during the year and showing the House how they have been filled up. There have been, as far as my information goes, three such vacancies in the posts of Forest Economist, Silviculturist and Chemist. Now, the first two of these posts were originally held by European officers and their successors are also Europeans and I think I can satisfy the House that the selections made were for good and sufficient reasons. These posts, Sir, require not only a very sound know-

ledge of Forestry and all connected branches, but also—and this is even more important—a very wide experience of Forest administration. Now, as the House knows, that experience and that knowledge can in the present circumstances only be sought in the ranks of the Forest service. There are practically no Indians in the senior ranks of this service. It was not until 1920 that Indians entered the service in any considerable numbers and the House will realise therefore that it must be some years before Indian officers of sufficient seniority and experience are available for selection to these special posts. But when they are, the House may rest assured that they will have their chance. The third appointment was held by Dr. Simonsen. When he went we found that the institution really needed a Biochemist and we appointed an Indian, Dr. Sen, to that post.

Now, Sir, let me come to the special experts The House knows that it has been our policy in practice to understudy these experts with Indian assistants and so far as I know there is not the slightest reason for anticipating that we shall depart from that policy. We shall as far as possible adhere to it. But Sir, what I do want the House to realise is this, that these special posts which deal with very highly technical subjects require not merely men with special qualifications, but what is even more important, with very wide experience, and if, therefore, a young assistant, after two or three years as understudy, is still not found fully qualified to assume the headship and direction of these highly technical and specialised branches without further training the House must not assume that we are departing from our policy. I think, Sir, so far as Indianisation is concerned, I have shown definitely what the policy of Government is, what we are doing and what we propose to do to carry it into effect.

Now Sir, I come to the question of the new college and I am glad that my Honourable friend has given me the opportunity of saying something about this new institution, which we hope to inaugurate before the end of this year. Let me take the House back to the Resolution of 1922 which recommended that Indian Forest probationers should in future be trained at Dehra

Dun as soon as facilities could be provided. I may say that we have done our very best to bring that scheme to fruition and I am glad to say that it is now complete. I hope very shortly to make available for publication full details in regard to the college, in regard to condition of entry, the course of study, the rates of fees, the facilities for accommodation, etc. As I shall make public, I hope very shortly, complete information on all points, I shall content myself now with a brief indication of the scope of the institution and shall also reply incidentally to one or two questions which my Honourable friend has put. Sir we hope that this new institution will be a centre of instruction in the science of tropical forestry and its connected branches, which will be second to none in the world. With the magnificent Forest Research Institute at its doors, this institution will be in the position of being able to make its course of instruction unique. We are also now, Sir, reaping the reward of many devoted years of service on the part of the Forest Department and we have now available in India the results of scientific forestry under tropical and sub-tropical conditions, which I think, cannot be equalled, and certainly cannot be surpassed in any tropical country in the world. (Applause.) Now, Sir, working under these favourable conditions and with these advantages, we propose to see that our standards of instruction and of examination will be such that the diploma of this college will be regarded as the hall-mark of the highest efficiency in scientific forestry.

Turning now to the questions of my Honourable friend, we hope, Sir, to open these courses in November. As regards the expenditure the only capital expenditure that will be necessary will be in order to render the existing accommodation suitable for the type and class of students whom we may reasonably expect to get. We do not anticipate that this will exceed Rs. 1,89,000 and provision for this amount has been made in the coming year. As regards the recurring expenditure, it is a little difficult to estimate with any exactness what the extra cost on this account will be. But I think I may say generally that if certain readjustments and rearrangements of staff under the Government of India, which are now under examination, are carried out, that the new institu-

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tion should cost very little, if anything, over and above the actual recurring expenditure which is now being incurred.

Then, Sir, I come to the question of the classes of students who will be admitted. The college will be open first of all to Indian Forest probationers; it will also be open to private students and to students sent either by Indian States or by Provincial Governments. We look forward to the time when this college will attract to itself students from all parts of the world interested in tropical forestry. My Honourable friend has referred to the cost of training. The cost as estimated is certainly somewhat high. We estimate it at Rs. 2,400 a year. But it must be remembered, Sir, that we are going to give a training which will be equal to that normally obtainable in any forestry school in Europe, and that being so, we cannot do it cheaper. But Rs. 2,400 includes not merely charge for tuition, it includes charge for accommodation, for light, water and certain other services; and taking into account the fact that the present charge for Rangers' courses at Dehra Dun is Rs. 1,500 and that for Provincial Forest men is Rs. 1,750, if we exclude Rs. 300 which is the rent for the rooms that these students will occupy, I do not think that the balance of Rs. 2,100 is excessive. Sir, I think I have now covered most of the points raised by my Honourable friend. As I have already said I propose to publish very full information on all points connected with the new institution, either in the form of a Resoluton or in some other form which will be made available to the public.

Diwan Bahadur T. Rangachariar: Sir, I beg to withdraw my amendment.

The motion was, by leave of the Assembly, withdrawn.

Mr. President: The question is:

"That a sum not exceeding Rs. 8,69,000 be granted to the Governor-General in Council to defray the charges which will come in course of payment during the year ending the 31st day of March 1927, in respect of 'Forest.'"

The motion was adopted.

(*Legislative Assembly Debates.*)

REPORT OF THE SCHOOL OF FORESTRY.

UNIVERSITY OF OXFORD.

For the Academic Year 1924-25.

Students.—The number of students attending courses of instruction was as follows:—

Michaelmas Term	...	...	...	32
Hilary Term	...	...	...	31
Trinity Term	...	...	..	31

Six students passed the Final Examination for the Degree and three were awarded the Diploma in Forestry under the old regulations, which have now been superseded. There were no students studying for the Diploma under the new regulations.

Lectures and Laboratory Instruction.—Lectures and laboratory instruction were given as follows:—

The Professor: Silviculture, Forest Protection, and Forest Utilization.

Mr. R. Bourne: Forest Management (including Mensuration and Valuation), Forest Utilization.

Mr. N. F. MacKenzie: Surveying and Forest Engineering.

Mr. W. E. Hiley: Forest Botany, Economics of Forestry.

Mr. W. R. Day: Mycology.

Mr. L. Chalk: Structure and Identification of Wood.

Mr. N. Cunliffe: Forest Zoology.

Mr. H. S. Williamson: Forest Law.

Mr. E. C. Robbins: Economics.

Field Work.—Practical tours on the Continent were organized during the Easter and Summer vacations. The Professor of Forestry was in charge of parties in France, Czecho-Slovakia and Austria and Mr. R. Bourne gave practical instruction in France and in the Parmoor woods in the Chilterns. With the permission of the President and Fellows of St. John's College, full use was made of Bagley Wood as a demonstration area during Term. Field instruction in Surveying and Forest Engineering was given by Mr. MacKenzie.

Research and Publications.—Mr. R. N. Aldrich Blake continued his work on the root action of tree seedlings.

The following papers have been published:

Troup, R. S.: 'Vegetation Study and Plant Ecology in relation to Forestry.' (Report of Imperial Botanical Conference, 1924.)

Troup, R. S.: 'The Management of British Woodlands.' (British Association, 1925.)

Hiley, W. E.: 'The respective Advantages and Disadvantages of long and short Rotations.' (British Association, 1925.)

R. S. TROUP,
Professor of Forestry.

29th January 1926.

ANNUAL REPORT OF THE IMPERIAL FORESTRY INSTITUTE.

UNIVERSITY OF OXFORD.

For the Academic Year 1924-25.

Constitution and Staff.

The Imperial Forestry Institute, created as a result of the recommendations of the British Empire Forestry Conferences of 1920 and 1923 and the Interdepartmental Committee on Imperial Forestry Education (1921), started work in October 1924, and this Report deals with the first year of its existence. The staff, which is not yet complete, is at present constituted as follows:

Director.

Professor R. S. TROUP, C.I.E. M.A., D.SC. (Oxon.).

Lecturers and Demonstrators.

Silviculture ... THE DIRECTOR.
H. M. STEVEN, B.Sc., Ph.D. (Edin.). Hon. M.A. (Oxon). Forestry Commission Research Officer attached to Institute.

Forest Management	R. BOURNE, M.A. (Oxon.).
Economics of Forestry,	W. E. HILEY, M.A. (Oxon.).
Mycology ...	W. R. DAY, B.SC., M.A. (Oxon.).
Structure and Properties of Wood.	C. C. FORSAITH, Ph.D. (Syracuse, U.S.A.) L. CHALK, B.A. (Oxon.)
Entomology ...	J. W. MUNRO, D.SC. (Edin.). Hon. M.A. (Oxon.), Entomologist, Forestry Commission, attached to Institute.
	R. N. CHRYSTAL, B.SC. (Edin.).
Forest Botany ...	J. BURTT DAVY, Ph.D. (Cantab.).
Surveying and Engineering.	N. F. MACKENZIE, Hon. M.A. (Oxon.).
Forest Law ...	H. S. WILLIAMSON, MA. (Oxon.).
Secretary	P. S. SPOKES, B.SC., MA. (Oxon.).
Assistant Secretary...	Miss K. M. L. SIMPSON, M.A. (Cantab.).

Mr. H. G. Champion, M.A. (Oxon.), was appointed Lecturer in Silviculture, but did not take up the post ; he was engaged temporarily during the Hilary and Trinity Terms in teaching Systematic Botany pending the arrival of Dr. J. Burtt Davy, who took up his duties at the end of the year. This subject was taught during the Michaelmas Term by Mr. C. E. C. Fischer. Lecturers in Silviculture, Forest Utilization, and Soils remain to be appointed.

Buildings.

The work of the Institute was carried on, as a temporary measure, in the School of Forestry ; an extension for immediate needs, in the shape of a laboratory and five working rooms, was completed towards the end of the year. The erection of suitable buildings on a new site is a matter of urgency, since the present accommodation is inadequate and the development of the Institute is hampered in consequence : this matter is receiving attention.

Students.

The number of students attending courses of study for the whole year or for shorter periods was 22, as follows :—

Post-graduate probationers :

Great Britain	1
Colonial Services	10

Forest officers on leave :			
Colonial Services	...	...	7
India.	...	...	1
Students doing special work in the structure and properties of wood			3
			22

Courses of Study.

These were adapted to the needs of each student. The probationer for Great Britain specialized in forest management including working plans and silvicultural systems. Probationers for, and officers on leave from, the Colonial Services received instruction of a general or special kind according to requirements, stress being laid on subjects likely to be of direct use to them in their respective Colonies, including tropical systematic botany and silviculture, structure and properties of wood, the utilization of tropical forest products, and other subjects ; more general subjects, such as surveying and engineering, forest management, etc., were dealt with according to the exigencies of each case.

A special feature of the training was the practical instruction given on the Continent for the purpose of studying the latest developments in silvicultural systems, forest management, and exploitation : during the Easter and Summer vacations the Director had charge of parties in France, Germany, Czecho-Slovakia, and Austria, and Mr. R. Bourne conducted similar tours in France and Switzerland. A gratifying feature of these tours was the cordial co-operation of the forest officers concerned.

Some of the Colonial Service students underwent a short course of instruction in systematic botany at Kew, and special thanks are due to the Director of the Royal Botanic Gardens for providing facilities in this respect. The three students undergoing training in the structure and properties of wood worked under the guidance of Dr. Forsaith.

Research.

The staff of the Institute was fully occupied during the year in the work of arranging and giving courses of instruction

purchasing equipment, preparing material, and other preliminary duties, and had no opportunity for undertaking research work. The question of prosecuting research will not be lost sight of when the Institute is in full running order.

Museum and other Collections.

A large number of specimens of timber and other forest products from Great Britain, the Dominions, the non-self-governing Dependencies, and India are being received, chiefly from the exhibits of the British Empire Exhibition, Wembley. These, which will be referred to in more detail in next year's Report, will form a valuable nucleus for a more complete collection of forest products.

Herbarium specimens, for the most part gifts, have been received from various sources :

Bolus Herbarium, University of Cape Town. A parcel of specimens received from the Curator.

Burma Forest School. The bulk of the Herbarium Collection consists of specimens from this school.

Budlong, Miss. Specimens of trees from the Coast Range mountains of California.

Burtt Davy, Dr. 235 specimens collected in Canada and the United States, and 39 specimens of British plants.

Darker, Mrs. 300 Himalayan plants.

Hiley, W. E., Esq. 16 specimens from Canada.

Kew, The Director Royal Botanic Gardens. Duplicates from the Stolz East African Collection, and 400 specimens of Javanese plants.

Madras Forest College.—A small collection.

Yale Forest School, by Professor Record. A parcel of tropical American trees.

The best thanks of the Institute are due to the donors of these collections. The number of specimens and the composition of the collection are at present inadequate, but further collections of specimens have been promised from various sources, and it is hoped that the difficulties felt during the past year, owing to the lack of material, will soon be at an end.

Financial.

The accounts of the Institute will be published separately in the *Oxford University Gazette.*

R. S. TROUP,

9th December, 1925. *Director, Imperial Forestry Institute.*

Approved and adopted by the Board of Governors of the Imperial Forestry Institute.

CLINTON,

9th December, 1925. *Chairman.*

LIONS NEAR JHANSI.

From a reliable source to-day comes the news of the shooting of a lion within 25 miles of Jhansi. Jhansi has a good reputation among shikaris but this information will certainly be received with surprise by sportsmen and others interested in Indian fauna. The Imperial Gazetteer and modern reference books generally refer to the lion as being extinct in India except in the Gir Junagadh forest of Kathiawar and possibly certain states of Rajputana. Until the early part of last century lions were not uncommon in Hariana, Khandesh, Rewah and as far east of Palamau, but for the last few generations records of the animal having been seen in any part of India except Kathiawar are rare. An official reply in the United Provinces Legislative Council declared that the last lion shot near Allahabad was one met with at Naini fifty years ago. Our correspondent, too, mentions that some years ago a lioness and two cubs were seen near Jhansi and it is presumed that the animal shot was one of the cubs which has become fully grown.—[*The Pioneer.*]

A theory concerning the lion which was shot recently near Jhansi by the Raja of Katera is put forward by a correspondent in a letter appearing in another column to-day. He recalls that the late Maharaja Scindia of Gwalior, some time about 1908 released from his zoological gardens a large number of African lions with the idea of re-stocking his jungles with the lion. Owing to the destruction which they caused an effort was made to recapture them. Most of them were recovered; but our correspondent understands that a few evaded capture, and it was

supposed they had died or been killed by other animals. Our correspondent's suggestion that the animal shot by the Raja of Katera may have been a descendant of one of the lions released from Gwalior is an interesting one and seems likely to be correct. We are endeavouring to procure further information on the subject which may lead to a confirmation of the theory.—[*The Pioneer.*]

Information received by us from various sources tends to confirm the theory put forward by our correspondent, that the lion recently shot near Jhansi by the Raja of Katera, the chairman of the Jhansi District Board, was a descendant of the African lions released from his zoological gardens by the late Maharaja Scindia of Gwalior. The private secretary to the present Maharaja Scindia believes that theory to be correct and both he and other well-informed correspondents bear out the statement that His late Highness let loose a number of African lions in his jungles between 1904 and 1910. Precise details are given in another column of the actual number of these animals and of the time and places at which they were set free. When these animals first found themselves out of captivity, they committed many depredations and were a grave menace to human life. Some of them were recaptured and others were killed, but there is uncontrovertible evidence that a proportion of them survived and settled down to their free life in the Gwalior jungles. These have been breeding since they have been at liberty and there are reliable records of a pride of lions, numbering six or eight having been seen on more than one occasion during the last few years. A young male was shot by His Highness the Maharaja of Baria a year ago.

While there is a considerable weight of evidence in favour of the supposition that the Raja of Katera's lion was of African origin or had African parents it is rightly pointed out in a letter appearing in *The Pioneer* to-day that the fact that the beast had a fine mane does not preclude the possibility of its having been of indigenous breed. Our correspondent's remarks on the subject are confirmed by the following quotation from Major T. C. Jerdon's "Mammals of India" written in 1867:—"It was

supposed that the Indian race of lions wanted the mane altogether. It has, however, been clearly shown by Blyth and others, that the absence of the mane in certain specimens was probably accidental, being torn off in the prickly jungles of those districts of India which it still frequents and that if allowed to grow, the mane was well developed." The Asiatic lion was long considered to differ from the African one in being smaller and less powerful and in wanting the rufous or vinous tinge generally associated with the African race but later observations tended to confirm the specific identity of lions from Asia and Africa.—[*The Pioneer.*]

EXPORTS OF STICK-LAC.

Exports of stick-lac from Singapore and Bangkok respectively during the month of March 1926:—

Export from Singapore.		Export from Bangkok.	
Countries of Consignment.	Quantity.	Countries of Consignment.	Quantity.
	Tons.		Tons.
Bombay	1·01	Singapore ...	50·56
France	2·01	China	·24
French India ...	4·33	British Malay States ...	·06
Bali and Lambok ...	·42	Holland	2·50
Germany	5·05	Germany	12·52
United States of America.	12·07	United States of America.	83·37
Total ...	24·89	Total ...	149·25

6th May 1926. [*Indian Trade Journal.*]

ANNUAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

Sir Leslie Wilson, Governor of Bombay, presided at the annual general meeting of the Bombay Natural History Society, which was held at the Prince of Wales Museum on the 9th March.

Sir Reginald Spence, the Honorary Secretary of the Society in the course of his report, gave an account of the work that the Society was doing in popularising nature study among students and the public generally, and is giving practical assistance to many public institutions by means of expert advice. In the course of his address Sir Leslie Wilson said: One of the most important features of the work undertaken by your Society is the help which it is able to give to the cause of education by providing facilities for nature study. I am glad to learn that there is full agreement between Government and your Society as to the measures that should be taken to encourage nature study in the Schools; but, like so many other excellent schemes, our proposals are hampered by want of funds. Government has already declared its approval of the following suggestions made by the Director of Public Instruction in consultation with your Society namely, the creation of an interest in the study of natural history among the teachers under training in the Secondary Training College, Bombay, by the establishment of a Nature Study Club closely associated with that College and secondly, the introduction of special courses in the vernacular training colleges. The proposals for the appointment of a Lecturer in the Natural History Section of the Prince of Wales' Museum, which are referred to in your report, have not yet been submitted officially to the Government, but even if we had received them, it is most unlikely that they could have found a place in the Budget owing to our difficult financial position this year. I agree, however, that it is very desirable that such an appointment should be made and I would appeal to those well-to-do citizens of Bombay who are interested in the question of nature study to help the Natural History Society to carry out their scheme for at least one year. At the end of that time it will be evident either that the work is

of such a nature as to deserve assistance from Government, or it will be shown that the time is not yet ripe for teaching nature study to the youth of this country. Personally, I believe that the experiment is likely to prove successful and I am anxious to encourage the teaching of nature study in the schools, especially as it is of so much interest to the Boy Scouts, who are now forming a very considerable proportion of our school-going population.

Appreciation of Society's Work.

We must all, I think, be very grateful to the Natural History Society for the assistance which it has rendered to schools and colleges, to hospitals and dispensaries, and to other public institutions in the course of the year, and the Society itself must be particularly grateful to Mr. F. V. Evans for his very valuable gift of books dealing with Western India and for the very interesting pictures of Bombay which are now on exhibition in the Art Section of the Prince of Wales' Museum. I trust that the proposed deputation of Mr. Prater to America will commend itself to your Society. I feel sure everyone shares with me a very keen appreciation of Mr. Prater's work, conducted, as it has been, under circumstances of considerable difficulty and inconvenience but with an ability which deserves all praise. Mr. Prater has conclusively proved that he can, to the benefit of Bombay, take advantage of the opportunities offered to him and I am sure that his proposed visit to America will be of the greatest value. The report shows what a large amount of money is spent in America on the study of Natural History, and on the up-keep of the Natural History Museum in New York, and I believe that Mr. Prater will gain very valuable experience from a study of what is being done there.

I have often spoken to people who have lived in Bombay for many years, and find to my great surprise, that many of them have never even been to the Prince of Wales' Museum and had no idea of the excellent Natural History Section we have there. If we could only get the public to realise what a great deal has been done during the last few years for the Natural History Section,

I believe the Society would get a very largely increased measure of support which it so thoroughly deserves.

All the members of the Society will agree with me when I say that it is impossible to overestimate the work which has been done for the Society by Sir Reginald Spence. The members of the Society know even better than I do how much time and thought he has devoted to the Society's work, and I feel sure that the best way of expressing our thanks to him is to obtain further recruits for the Society, and larger funds to enable it to carry on the excellent work which it is doing.

His Excellency Sir Leslie Wilson was re-elected President of the Society for the current year with Sir Norman McLeod, His Highness the Maharao of Cutch and Rev. Fr. Blatter as Vice-Presidents.—[*The Pioneer.*]

UTILISATION OF SAWMILL WASTE.

A subject to which considerable attention and research may be profitably paid is the question of the disposal of wood waste from sawmills in all parts of the country. Vast quantities of sawdust from the saws accumulate in the mills, and although in some cases it can be used as fuel, a specially-constructed fire-box is necessary to burn this finely-divided material. This is, however, by no means a sufficient outlet for the supply. In addition there is frequently a local demand for sawdust for such purposes as food packing and curing, for fireworks and explosives. Methyl or wood alcohol can be obtained from sawdust by a distillation process. Wood alcohol is indispensable to various chemical industries and has so far been produced only by the destructive distillation of wood. A companion product of the distillation is acetate of lime, from which are derived acetic acid, acetone, acetic ether, and other substances used extensively in numerous chemical manufactures. All these processes, to be dealt with on a commercial basis, require the accumulation of sawdust in large quantities; in this country transport is expensive, and mitigates against any collective effort to manufacture useful chemical or other products from sawmill waste,

Another outlet for sawdust and other forms of mill waste lies in converting the material into ethyl or grain alcohol, and it has been suggested that in the future ethyl alcohol derived from wood will be one of the most important motor fuels. Because of its insulating, absorbent and resillient properties sawdust has many mechanical uses; amongst these are heat and sound insulation in walls, floor-sweeping compounds, packing for fragile articles, composition flooring and wood flour. "Hydrolyzed" sawdust—sawdust which has been cooked with a weak acid in such a way as to convert a part of its cellulose into sugar—has been used as food for cattle, but it is not to be presumed that English farmers are likely to make extensive use of sawmill waste however chemically treated, for feeding cattle.

As an outlet for Crude Sawdust may be mentioned certain casting operations in connection with foundry trades, as a cleansing agent and as a polish in the case of boxwood dust used by jewellers. It is also used as absorbent litter in stables or garages, as insulating material for walls, packing for ice blocks and the manufacture of composition boarding. In the heavy chemical trades it may be used as packing for the transport of carboys containing acids, in connection with the transport of which a cheap absorbent packing, capable in the event of breakage, of preventing the spreading of dangerous liquids, is necessary. In the food packing and curing trades, apart from the packing of goods for export, hardwood dust is used in smoking fish, sausages, etc. The obvious uses in the toy trade are the packing of toys and the stuffing of dolls. Its use as a paper-making material is restricted because not only does it introduce difficulties in the cooking process, but it also limits the length of the fibres and produces an apparently poor grade of paper.

Further Use.—Chips and sawdust are used to some extent as sweeping compounds generally treated with antiseptics, and for the manufacture, more particularly on the Continent, of briquettes; also of floor coverings and bases for explosives.

Coming to the question of chips from planing machines, if they are not usable after being carbonised as charcoal or as fuel

they can be disintegrated by special machinery and made available for all uses to which sawdust is applicable.

The whole question is, of course, wrapped up with the question of availability of supplies in commercial quantities, but perhaps the outlets mentioned may be helpful to sawmillers in dealing with a difficult problem.—[*Timber News.*]

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INDIAN FORESTER

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PRELIMINARY INVESTIGATION INTO THE CAUSE AND CURE OF THE SPIKE DISEASE IN SANDAL (*SANTALUM ALBUM*) IN THE NORTH SALEM DIVISION, MADRAS PRESIDENCY.

BY W. C. HART, P.F.S., and S. RENGASWAMY, RANGER.

INTRODUCTION.

The first indications of the spike disease in sandal in the North Salem Division were noticed at the time Mr. McCarthy was the District Forest Officer, in the year 1913 in the Javalagiri R. F., in two small areas—(1) In Bamboo Block V north-east of the Sinnei Guntai Tank, about 30 acres, (2) near Parathavadi Bail about three miles south-east of the above area and within a mile east of the Forest Bungalow, a single spiked sandal.

In January 1915 a single spiked tree was noticed by Mr. C. C. Wilson, Working Plans Officer near Mahadeswarangudi in the Tholuvabetta R. F., about 20 miles south-east of the Javalagiri R. F. and later in the same year the enumeration surveys revealed the existence of a few spiked sandal about four miles east of the Mahadeswarangudi area.

In about May 1915 spiked sandal was observed near Batchecheruvu, in the middle of the Thalli R. F. close to the Mysore frontier and about eight miles north of the Javalagiri R. F. Considering that the disease was first recorded in Mysore and Coorg in 1898, and probably existed there several years before that, it is obvious that the spread of spike has taken an east-

north-eastern direction towards the Salem District, corresponding to the general direction of the south-west monsoons. The accompanying map will show to what an alarming extent the disease has spread in North Salem from 1913 to date. It is surprising how the disease, besides spreading outwards from a nucleus, has jumped large areas of sandal and appeared in isolated patches miles away. Whereas in 1913 spiked sandal in North Salem occurred in two small patches, probably not more than 30 acres in extent, it is now estimated to cover about 20,000 acres in twelve patches, some of them comparatively large. The number of trees extracted, their outturn and the revenue realised, have increased proportionately from 1917 onwards, as shown in the following statement :—

Year.	No. of Trees extracted.			Outturn in tons.	Revenue in rupees.	Remarks.
	Heartwood.	Sapwood.	Total.			
1917-18	8,363	[illegible],210	11,573	$39\frac{1}{4}$	63,731	There is no record of the actual extent of the spiked areas in each year from 1913 to 1924, though from 1924 onwards a record has been kept.
1918-19	10,342	2,527	12,869	$53\frac{1}{2}$	70,547	
1919-2	7,189	1 524	8,713	$63\frac{3}{8}$	88,502	
1920-21	6,448	1 91[illegible]	8,358	$73\frac{3}{8}$	112,087	
1921-22	13,686	1,608	15,294	$130\frac{3}{4}$	146,126	
1922-23	16,508	790	17 298	$130\frac{1}{4}$	151,824	
1923-24	8,274	7,337	15,611	220	214,089	
1924-25	22,546	31,422	53,968	235	276,032	
1925-26	23,273	48,406	71,679	$275\frac{3}{4}$	306 889	
Total ...	116,629	98 734	215,363	1,221	1,429,827	

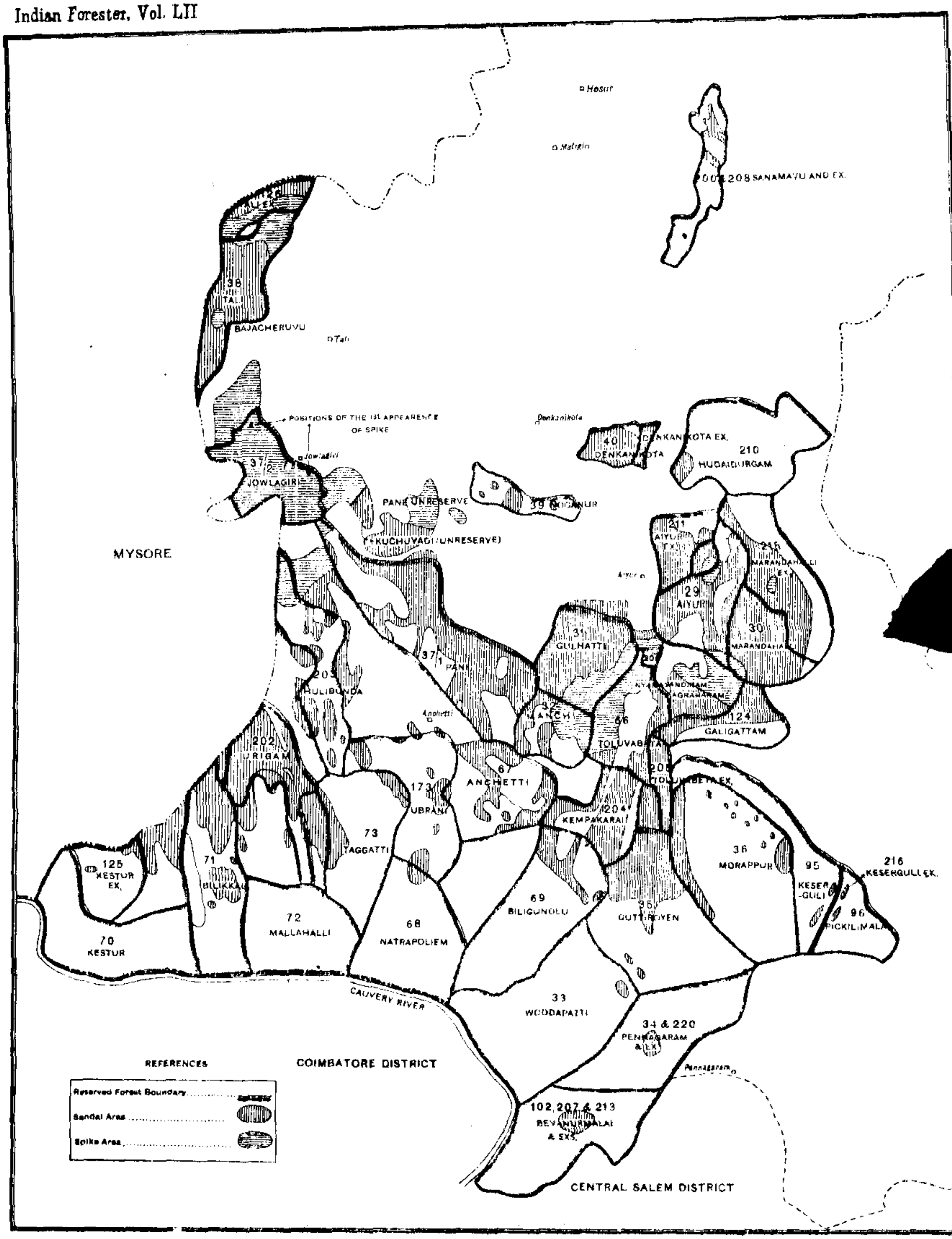
It will be observed that the percentage of the extracted sapwood trees to the total is about 46. Obviously, as the same areas are being worked year after year and the younger age classes are considerably greater in numbers than those yielding heartwood, we should be draining more and more our reserve fund of

MAP SHOWING SANDAL AREAS IN THE NORTH SALEM DIVISION

AND PORTIONS ATTACKED BY "SPIKE"

FIRST QUARTER OF 1926

Scale 1 Inch = 6 Miles



saplings, and if no sure method of permanently freeing an area of spike is discovered, we shall reach a stage when sandal will disappear completely from these areas.

Mr. H. A. Latham, Conservator of Forests, in his Madras Forest Bulletin No. IV of 1922-23 has worked out a loss to the Government of 2⅓ lakhs of rupees on every 4,960 spiked sapwood trees uprooted. Therefore the total loss incurred by the Government of Madras from 1917 to 1925 in the North Salem Division alone, by the extraction of these trees, is calculated by simple proportion at Rs. 47 lakhs nearly.

As a spiked sandal tree has never been known to recover, it may as well be uprooted, in the hopes of minimising the spread of infection. Up to date, extraction of diseased trees appears to be the only possible means whereby an area can be temporarily ridded of spike, as is evidenced by two areas in the Noganur R. F. and near the Irupal Naicken Tank bund respectively, where spiked trees were noticed in 1922 and were removed promptly, resulting in no recrudescence of the disease. There is nothing, however, to prevent the fresh infection of these areas.

Much has been written previously on this subject by various Forest Officers, as Messrs. P. M. Lushington, H. A. Latham, T. N. Hearsey and Dr. Coleman, Director of Agriculture, Bangalore, but there was no continuity of action owing to the inevitable transfers which Government service involves. It is true that Mr. Hearsey was for three years on special duty in this work, but he restricted his observations to certain insects, particularly the red spider—which by the way is very scarce in these spike areas now—and sowing seeds from partially spiked trees. Mr. Hearsey's period of special duty on spike investigation terminated in the middle of 1919, with the conclusion that "all observations, *i.e.*, spread, distance, isolated attacks, etc., point to a carrier." Then several Rangers were placed by Mr. Latham, Conservator of Forests, on special duty, one after the other, on recording observations in spiked areas in the Javalagiri R. F. near cairn No. 53, in the Javalagiri Bungalow area, and in the Mahadeswarangudi area (Tholuvabetta R. F.). Also, the Nelkundi spike area and Batchecheruvu area were ordered to be inspected regu-

larly and spiked trees removed as soon as found. Grafting and pruning experiments with spike sandal were also to be carried out, but the work appears to have been neglected, owing probably to frequent changes of Rangers, and their probable apathy towards a work carrying no perquisites.

We must endeavour to find out the real cause of infection and a surer and easier means than extraction of combating the scourge. With this object in view the experiments detailed below were started from May 1924 onwards. They can be added to considerably, and suggestions from, and the co-operation of others similarly interested, are welcomed.

These experiments are divided into the following groups :—

I. Observation of demarcated spike areas.

II. Experiments to determine the cause and cure of spike.

III. Germination tests of sandal.

These will be dealt with in order.

I.—OBSERVATION OF DEMARCATED SPIKE AREAS.

The object is to test the rapidity and direction of the spread of the disease, and the approximate minimum age or girth when plants get diseased. Also to determine the effect of lantana growth on the spread of spike, as lantana has been suggested as a possible contributing agent to the malady.

(*a*) *The Javalagiri Bungalow area.*—This is 4·6 acres in extent, and was kept under observation from January 1916. 444 sandal trees had been marked for observation. By 1924 all these trees had developed spike and were removed at the time infection was noticed. But the area is stocked now with a fresh crop of healthy seedlings, coming up under a dense growth of lantana ; 6 spiked saplings were removed in the middle of 1925, but no attacks were observed since.

(*b*) *Cairn No.* 53 *observation area* (*Javalagiri R. F.*)—The area, about 4·5 acres in extent, was opened by Mr. Hearsey in 1916. 513 trees were selected in the area and kept under observation. But in 1922 the area was divided into 3 plots A, B and C, the extent of each being 3, 0·85 and 0·85 acres respectively. In B and C lantana was uprooted and A was left with lantana. Also in plot B,

spiked trees were left to die, whereas in C they were removed promptly.

At the time of this report, there are only 10 healthy trees in the area, 9 in plot C and 1 in plot B, but it is not known how many trees were observed in a healthy condition in 1922, when the area was divided into plots, and so it is not possible to deduce any conclusions now.

In January and February 1925, the area was reduced to 4 acres by omitting the unreserve portion (½ acre) from plot A, and the area was re-enumerated and fenced with barbed wire as a protection against cattle and deer. All saplings above 1½ ft. in height were numbered and the distribution was as follows :—

Plot A 878, Plot B 252 and Plot C 167. The main objects of re-enumerating and continuing the periodical observations are:—

(1) to test the effect of the removal of lantana on the incidence of spike.

(2) to note the direction of the spread of disease.

(3) to find out the minimum size at which sandal becomes attacked, and

(4) to test the effect of non-removal of infected trees.

Regarding the first object, 46 out of 878 in plot A, 4 out of 252 in plot B and 9 out of 167 in plot C were observed to be spiked by March 1926 ; *i.e.*, 13 out of 419 in the lantana cleared area and 46 out of 876 in the area not cleared of lantana, iving the approximate proportion of 3 : 5.

(2) From the map of the plots maintained, the distribution of the spiked trees shows the spread from south-west to north-east.

(3) The minimum size so far found spiked in this area had a girth of half an inch at base.

(4) No definite conclusion can be arrived at now as some more time must elapse.

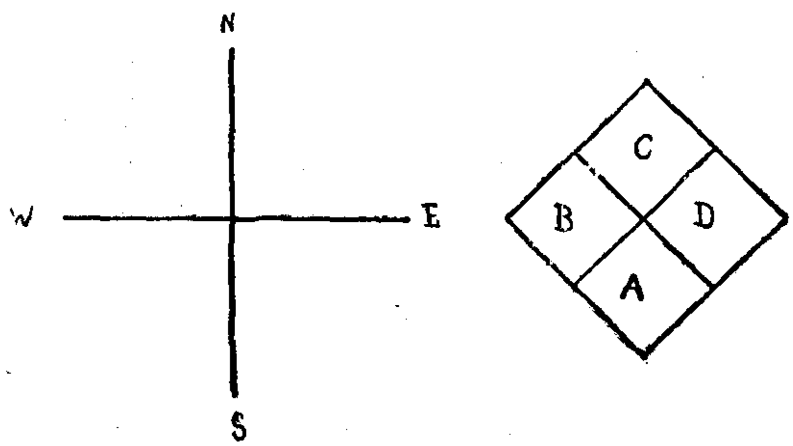
The results given above cannot be taken as conclusive and further observations are being recorded.

(*c*) *Mahadeswarangudi area.*—This was started in 1916, and 341 healthy sandal trees were ticketed and kept under observation in 30 acres. It was within this plot that the single spiked tree was found by Mr. Wilson in 1915. At the present time there are only 21 healthy trees in this area. No further attacks have been noticed during the past 2 years. It is very strange that between January 1922 and December 1922, 312 out of the above 341 trees were taken out, spiked, which indicates that the work was neglected previously by the Special Duty Ranger.

(*d*) *Hanumantharayangudi area.*—Eighteen sandal trees were selected by Mr. Hearsey in 1916 as having what he termed "Lanky Degeneration," which he believed was the first symptom of spike. One of the trees was found naturally dead and removed in 1920. In 1924 spike appeared in the unreserve adjacent to this area, and on 25th September 1925 one of the remaining 17 trees was observed to be infected. The other trees look perfectly healthy and present no difference in appearance from normal trees in non-spiked areas. So the one spiked tree of the 18 "Lanky Degeneration" ones probably received infection from the adjacent spike area. These trees will continue to be kept under observation with the object of seeing whether the prompt killing of infected branches by Atlas solution will stay the spread of infection to the remainder of the tree.

(*e*) *The Nyamasandiram Agraharam Observation Area.*—This is a new one opened in July 1925, 4 acres in extent, and divided into four sections, diagonally, facing south-west and north-east Two diagonal sections B and D are kept clear of lantana, and spiked trees are removed as soon as noticed. Of the other two diagonal sections A and C, section C will be cleared of lantana and A left as it is, while in both, the spiked trees will be left to die. This will give us data on the direction of spread of the disease and the efficacy or otherwise of removing lantana. All round the plot a belt of 100 yards will always be kept clear of spiked sandal. The whole plot has been fenced with barbed wire. The enumeration and ticketing of trees and saplings (above 1½ feet high) in the four sections has given 295 in section A, 180 in B,

155 in C and 690 in D, *i.e.*, a total of 1,320 sandal plants over 1½ feet high in four acres. The number of smaller seedlings is considerable. This is a common type of spiked sandal area, and it will be noticed how fully it is stocked with natural regeneration.



The results of observations up to date show that here also as in the cairn 53 area, the direction of the spread appears to be that of the prevailing monsoons at the time sandal is flowering, *i.e.*, the south-west monsoons from south-west to north-east. The significance of a reference to the flowering of sandal will be explained later in this report.

II.—Experiments to Determine the Cause and Cure of the Disease.

(a) Whether sandal is cross fertilised.—We require this knowledge to ascertain whether an attempt to isolate a resistant strain of sandal will meet with any serious difficulties.

683 inflorescences of sandal were stripped of everything but one un-opened bud; 485 inflorescences were chosen before any bud had opened, and also 325 inflorescences containing buds and flowers. Each inflorescence was covered over with muslin. In the first instance no fruit was obtained, in the second four

resulted, and in the last, two fruits. These results were obtained three months after tying the muslin, when all the inflorescences were dead.

Again, 170 inflorescences were ticketed and observed, without being covered over, and yielded 139 fruits.

This result indicates that not only is sandal cross fertilised, but that the main agency of fertilization of the flowers of one tree is through the agency of pollen from the flowers of other trees. It may be that a covering of muslin retards the development of buds and fruits, which needs further investigation.

(b) Whether plants raised from the seed of healthy sandal trees found in areas which have long been spiked are more or less immune from the disease.—It is observed that certain mature trees though situated in severely spiked areas, have not been infected and appear to be apparently immune from the disease. Seeds were collected from such trees of the Javalagiri 1913 area and sown, resulting only in two surviving seedlings, which are now about 9" high. These will be watched carefully and attempts will be made to infect them when they grow larger.

As the trees from which such seeds were obtained in this Division are not sufficiently mature, it cannot be presumed that they have long been immune from spike. Therefore, seeds have now been obtained from big healthy trees in very old spiked areas of North Coorg and sown. The result will be watched.

(c) What insects feed on sandal or attend sandal flowers.—Insects of the following natural orders were collected from spiked and healthy sandal trees in spiked areas, and sent to the Imperial Forest Entomologist, Dehra Dun, for identification.

Two species of LYCIDAE, red winged insects, found feeding on the pollen and nectar.

The larvæ of Terias Hecabe in three stages, found feeding on sandal leaves.

A species of Cryptocephalus of the order Chrysomelidæ. This also is a red winged insect found on sandal flowers.

A species of Sympiezomias of the order Curculionidæ, which defoliates sandal from May to November.

A species of Sphenoptera, natural order Buprestidæ, a violet coloured insect that frequents the petioles and tender twigs.

Monophlebus, natural order Coccidæ, found boring into a healthy sandal sapling.

Larvæ of probably Pyralids, Cerambicids and Lasiocampidæ which feed on sandal leaves at night and remain on the bark by day time.

Larvæ of Lepturinæ and Buprestidæ, the former of which is said by the Imperial Forest Entomologist to be of considerable interest. These larvæ were boring in living spiked sandal sapwood.

Another borer recently sent in a live condition in a living stem it was found in, has not been identified as yet, but is being reared at Dehra Dun. Practically all the above species are new to Dehra Dun.

Specimens are also being collected for a professional Entomologist in Austria, who is in touch with the British Museum, and has sent at his own expense entomological apparatus.

(d) Can sandal be infected by grafting on it spiked Zizyphus and vice versa ?—This experiment was suggested by Dr. Coleman and 40 grafts were tried, with no success. This is what might reasonably be expected.

(e) Pruning and tarring spiked branches.—Sixteen spiked trees were selected for experiment, and the spiked branches pruned from time to time, the scars being treated with tar from 19th July 1924. At the same time 16 spiked trees with no branches pruned were kept under observation. Out of the first lot, three trees still contain healthy branches, whereas the other set of trees became completely spiked in every twig; most of them were dead by 13th September 1925 and consequently removed. Further investigation is needed.

There were plenty of infected trees nearby and we could not say whether the recrudescence on the pruned trees was due to reinfection, or to the original infection. Hence 8 more spiked trees were selected on 28th February 1925 and pruned. To lessen the possibilities of reinfection, all spiked trees to a radius of 100 ft. around each tree selected for pruning were uprooted. These 8 trees were kept pruned from time to time as new spiked

branches appeared. Out of these, only two contain healthy branches now, and the advantages of the removal of the adjacent trees are not perceptible. Possibly, the width of the cleared strip was not sufficient to stop reinfection.

If the original infection is through the atmosphere, a tree newly spiked, if coppiced, should give healthy coppice shoots. To test this, coppicing of several trees was done, 5 in the early and 19 in the later stages of spike. None of the former threw up shoots but three trees of the latter produced shoots which were spiked. Mr. Latham suggested that the attacked branches might be pruned at different distances from the point of infection and the result noted. This was done, but still spiked shoots continued to spring from behind the pruned surfaces. As the area is full of spiked trees, this experiment had better be repeated in a newly spiked area, to escape the possibilities of reinfection from outside.

(f) To test whether infection takes place from the remains of spiked trees.—Two experiments have been started.

(1) Fully spiked living trees were uprooted and attached to four healthy sandal trees in the Range compound at Denkanikota The experiment was started on 5th February 1925, and in order to increase the chances of infection, several instalments of freshly spiked trees were brought and attached to these healthy ones. None of the trees have exhibited clear indications of spike as yet, though one looked suspicious six months ago. As spiked sandalwood has been coming into this Range compound (which is also the depôt) for the past 13 years, it is time infection reached the trees in the depôt, if such were possible.

(2) With the same object in view, a plot of one acre has been demarcated in the Nyamasandiram Agraharam R. F., and all trees and saplings in the plot, amounting to 1,201 in number, have been numbered with the aid of tickets. All around this plot a belt of 100 ft. wide is kept free from spiked trees. All trees, immediately they are found spiked, are uprooted thoroughly, and branches, twigs, sapwood, etc., excluding the heartwood portion if any, collected in the respective pits and burnt immediately after extraction. The surrounding areas will be subjected to the usual

method of promptly extracting spiked trees but not burning every scrap of a tree in its pit. This area was started in February 1926 and results are awaited. The comparative rate of infection in the interior plot and in the areas outside will give us an idea of the efficacy of taking out and burning every bit of residue from spiked trees. Here, too, we have the danger of reinfection from outside agencies.

(g) To find out whether we are able to get healthy regeneration from the seeds obtained from the healthy branches of spiked trees.— This experiment is being conducted within a spiked and non-spiked area and the results will be watched. It is unlikely that any conclusion can be arrived at till several years. Healthy seedlings have been obtained up to date, but the question is, will they become spiked later in life? The Javalagiri R. F., which is completely spiked contains an average of at least 200 seedlings per acre, all apparently healthy.

(h) To see if there is a virus in the soil on which spiked trees grow.—Seedlings raised from seeds obtained from healthy trees at the Hosur Cattle Farm were transplanted on 21st August 1924 in fresh pits from which spiked trees were removed. The plants are all thriving and are about a foot in height now.

(*i*) Partially spiked saplings and trees were treated both around the roots and by injecting into the stem with—

(1) Brown sugar, (2) Magnesium sulphate, (3) Bone meal, (4) Potassium nitrate, (5) Sub-chloride of mercury, (6) Metal mercury, (7) Liquor arsenicalis and (8) Tincture of iodine.

A good effect was noticed in the case of those trees treated with mercury, sub-chloride of mercury, liquor arsenicalis, and tincture of iodine, in that there was no further spread of spike in the tree though some of the saplings died in their former spiked condition. This experiment is being repeated, using the above and other chemicals normally used in human ailments.

(*j*) The attempt to get rootshoots from newly spiked trees by trenching round them was a failure as none of the ten trees treated gave any shoots. The experiment will be repeated.

(*k*) *Dusting of pollen.*—Observations regarding the direction f the spread of spike lead one to imagine that a possible means of infection is the transference of pollen from the flowers of spiked trees to those of healthy ones in the process of fertilisation.

In support of this theory, we have not as yet seen a spiked seedling, that did not show indications of having previously flowered. There is no means at present of finding out at what age a sandal plant flowers, as the oldest plant in this Division, of known age is two years old, having been obtained from seed sown in May 1924 in a fenced area in suitable soil. These plants are 1 to 2 ft. in height. From actual records made in observation plots, the smallest seedling known to be spiked was 2′ 7″ in height and ½″ girth at ground level. There were other spiked seedlings in the same area 3′, 4′ and 5′ in height, with girths varying from 1″ to 1¼″ at ground level. There is no means of ascertaining the age of these plants, as in the struggle for existence, against drought, hard soil, fires, cattle and deer, the shoot of a natural sandal seedling dies down year after year, and only seems to establish itself when conditions are rendered favourable.

To obtain more reliable data, therefore, on whether a sandal plant will not show indications of spike until after it has flowered we must watch the seedlings of known age referred to above sown in a fully spiked area.

Two tests of this pollen theory have been carried out already.

(1) Six healthy saplings from 2″ to 3″ in girth in a heavily spiked area (Javalagiri) are prevented regularly from forming flowering buds—at least the buds are removed promptly. None have so far, during a period of one year, shown signs of spike.

(2) Ten healthy trees in the Bungalow compound at Aiyur and 6 in a private garden 3 miles from Javalagiri (non-spiked areas) had their flowers dusted with the flowers from spiked trees so as to transfer the pollen from one to the other and aid fertilisation and possibly infection. This was done on 25th July 1925 and results are awaited. The period of incubation of spike is not known.

(*l*) *Introduction of new hosts.*—It is just possible that spike in sandal might be caused by want of a change of diet, or an

insufficient number of hosts, on account of a super-abundance of natural sandal regeneration. So the Bungalow observation area at Javalagiri, over which spike had passed and exterminated every sandal tree and sapling, was chosen for this experiment. The whole area, 4·6 acres, was overgrown with a very luxuriant growth of lantana, and this lantana was uprooted in parallel strips about 5′ to 6′ broad. Along both sides of each cleared strip, seeds of sandal, mixed with those of a new host not growing naturally in the Javalagiri R. F., were sown at intervals in patches. Details of the sowings and results obtained up to the present are shown in the tabular statement on page 387.

The sowings carried out in May 1924, *i.e.*, at the time of the first rains after the dry weather, and the strips sown with *Pongamia* and *Tamarind* seem to have given the best results, particularly the former, where many of the sandal seedlings, though only two years old, have grown to a height of 2 ft. and over-topped the *Pongamia* in certain cases.

In the first hot weather (1925) there were many casualties in sandal and the hosts, due chiefly to the subordinates doing too heavy a weeding in the strips, and also due to the strips being cut from east to west, instead of north to south, affording less protection from the sun. It is very noticeable that the greatest percentage of success in the sandal sowings is to be found under dense shade trees, and in the absence of trees, under lantana. It has been observed throughout the sandal growing areas of this Division, that lantana is extremely useful to sandal in its early stages in affording protection from the sun, cattle and deer, though, as a host, it is of little use once the sandal passes the seedling stage. We can best realise the value of lantana to sandal by clearing an area of the former and attempting to raise a crop of the latter under a thin canopy of trees The sandal germinates well enough, but the first hot weather spells disaster, and the first rains invite deer and cattle to the open space created. The best way to regenerate a lantana area appears to be to clear it in strips about 4 ft. wide and 18 ft. apart, and to regenerate these strips, taking

care to put obstacles at the ends of the strips to prevent the promenading of deer.

In the area referred to above, for the introduction of new hosts, all the sandal seedlings have been ticketed, showing the year of sowing, and annual measurements of height and girth are recorded.

With the same object in view, natural seedlings in the adjoining spiked area have been selected, and cuttings of *Jatropha Curcas, Erythrina indica, Moringa pterygosperma* and *Bombax malabaricum* planted alongside. These are sprouting successfully and as they will form fast growing hosts the results will be watched with interest.

Again, the following plants were raised in the nursery at Javalagiri, and successfully transplanted in a spiked area. When they are well established, sandal will be raised under them.

1. *Shorea Talura*	... ...	257 plants.
2. *Melia dubia*	... ...	10 ,,
3. *Strychnos Nux-Vomica*	... ...	78 ,,
4. *Bombax insignis*	... ...	186 ,,
5. *Albizzia Lebbek*	... ...	2 ,,
6. *Dalbergia Sissoo*	... ...	412 ,,
7. *Tectona grandis*	... ...	241 ,,
8. *Albizzia odoratissima*	... ...	16 ,,
9. *Bombax malabaricum*	... ...	209 ,,
10. *Pterocarpus santalinus*	... ...	243 ,,
11. *Artocarpus integrifolia*	... ...	60 ,,

As sandal has been proved to be capable of imbibing strychnine from *Strychnos Nux-Vomica*, it will be interesting to see if the strychnine will act as a tonic to the sandal or an antidote to spike.

(*m*) *Whether spike is due to drought.*—Six spiked saplings and 6 healthy saplings have been kept profusely watered once a week from 25th October 1925. No improvement is noticed on the spiked saplings but the healthy ones continue healthy.

Results of sowings of sandal with new hosts in the Javalagiri Bungalow Observation Area.

Serial No.	Species sown with sandal.	1924. No. of patches sown.	1924. Date of sowing.	1924. No. of hosts now alive.	1924. No. of sandal now alive.	1925. No. of patches sown.	1925. Date of sowing.	1925. No. of hosts now alive.	1925. No. of sandal now alive.
1	*Jatropha Curcas* ...	134	23-8-24	69	12	62	28-4-25	19	31
2	*Pithecolobium dulce* ...	200	21-7-24	24	16	169	do.	67	29
3	*Tamarindus indica* ...	140	28-5-24	18	27	101	do.	6	12
4	*Melia dubia and indica* ...	174	28-5-24	32	49	105	do.	4	15
5	*Pongamia glabra* ...	140	24-5-24	61	49	63	do.	19	17
6	*Jatropha Curcas* ...	134	24-8-24	47	10	84	do.	39	45
7	*Tamarindus indica* ...	100	24-5-24	35	10	60	do.	13	10
8	*Pterocarpus santalinus* ...	183	18-9-24	...	9	175	29-4-25	...	19
9	*Tamarindus indica* ...	100	24-5-24	45	17	56	do.	19	8
10	*Bassia longifolia* ...	130	23-8-24	...	3	127	do.	...	9
11	*Pongamia glabra* ...	92	24-5-24	54	20	35	do.	10	10
12	*Pterocarpus and Bassia* ...	139	18-9-24	...	4	135	do.	...	17
13	*Pongamia glabra* ...	70	24-5-24	49	14	21	do.	16	10
14	*Shorea Talura*	80	21-7-24	...	5	75	do.	...	8
15	*Pithecolobium dulce* ...	40	21-7-24	7	3	31	do.	22	6

(*n*) *Treatment of spiked trees with Atlas Solution.*—On 22nd December 1925, 33 spiked sandal trees were girdled at about a foot from ground level, and the portion coated with Atlas solution, four other trees were girdled and left without the application of the solution. The trees were inspected on 22nd January 1926. All those treated with Atlas solution were dead above the portion coated and those merely girdled remain unaffected. As Atlas solution is useful in rapidly killing spiked trees, and if the pollen theory proves correct, this will be of great help in killing the trees before the flowering season and before actual extraction, to gain time.

This solution is now promptly applied to all spiked trees in the newly spiked area in the Gulhatti R. F. Ninety trees have been girdled and treated, of which the biggest trees, 30 in number, have also been treated on the roots by boring holes, to see if the root system can also be killed. The results will be watched.

(*o*) *To see if spiked Zizyphus Oenoplia is the cause of infection.*—

Half a dozen spiked *Zizyphus* plants were transplanted near healthy sandal saplings in October last, but all the *Zizyphus* died and no change in the sandal is noticed so far.

Half a dozen spiked *Zizyphus* plants were selected and sandal seedlings were transplanted around them at six plants to each. Only two of the sandal plants survive. The experiment must be repeated on a larger scale.

III.—GERMINATION TESTS OF SANDAL.

(*i*) *How long sandal seed will remain fertile.*— For this 6 or 7 measures of seeds were obtained in September 1924 and sowings are being carried out every month for the past 18 months and are to be continued for three years. Sowings are done at ½" and 1" depths under heavy and light shade conditions. The percentage of germination obtained up to date is given in the following tabular statement. The beds are watered :—

Period of storage.	Heavy shade.		Light shade.		Remarks.
	1" depth percentage of germination.	½" depth percentage of germination.	1" depth percentage of germination.	½" depth percentage of germination.	
Fresh ...	8·5	28·0	17·5	23·5	
1 month ...	16·0	28·5	26·0	13·5	
2 months ...	9·0	10·5	16·5	26·5	
3 " ...	7·0	9·5	9·5	19·5	
4 " ...	15·5	22·0	8·5	16·0	
5 " ...	19·5	14·0	15·5	25·0	
6 " ...	17·5	18·0	20·0	22·5	
7 " ...	12·5	21·5	21·5	22·0	
8 " ...	27·5	21·5	25·5	25·0	
9 " ...	21·5	22·5	21·5	32·5	
10 " ...	12·5	16·0	18·5	19·5	
11 " ...	15·0	11·0	6·0	15·0	
12 " ...	9·0	19·5	10·0	8·5	
13 " ...	20·0	11·0	8·5	16·0	
14 " ...	5·5	7·5	2·0	4·5	
15 " ...	3·5	9·5	3·0	6·0	Germination not yet complete.
16 " ...	5·5	10·5	...	...	
17 " ...	15·5	20·5	...	...	
18 " ...	...	...	...	...	

The percentage of germination shows no striking difference and sowings at ½" depth appear to give better results. The effect of shade on survival is being noted periodically. The soil conditions are the same.

(*ii*) *Prevention of rats and squirrels from eating sandal seeds.*—The seeds were treated with the following substances and left in accessible places:—

(1) Kerosene, (2) Red lead, (3) Acorus Calamus, (4) Copper sulphate, (5) Kerosene and red lead, (6) Juice of Azadirachta indica and (7) Magnesium sulphate.

Practically no attack was made in the case of items 1, 3, 4 and 5, and the seeds so treated, when sown, gave the following percentage of success of germination:—

(1) Kerosene ...	...	...	1½ per cent.
(2) Red lead ...	...	...	14 "
(3) Acorus Calamus	...	...	27½ "
(4) Copper sulphate	...	...	4 "

(5) Kerosene and red lead ... ... *Nil.*
(6) Juice of Azadirachta indica ... 10 per cent.
(7) Magnesium sulphate ... ... 16 „

Acorus Calamus seems to have given the best results. It is sold in Indian Bazaars (Tamil, Vasambu), and is probably the basis of Keating's powder.

In conclusion, we agree that there are many other experiments that may profitably be carried out with reference to spike in sandal and the best method of raising sandal; and it is only by the co-operation of others in localities varying in natural conditions, that a clearer insight into the problems confronting us may be gained.

For certain experiments regarding spike, it is obvious the best conditions will be met if they are conducted in sandal areas very far removed from spiked areas—a distance of at least 25 to 50 miles.

NOTE ON THE ALLOWANCE FOR INCREMENT IN POSSIBILITY CALCULATIONS.

The formula usually employed in the calculation of the yield of a forest involves the determination of the volume of its old wood which when divided by the period during which this volume is to be extracted gives the annual possibility. To ensure a sustained yield, however, it is necessary to make an allowance for the increment which the old wood would put on during the period of extraction, and this is done by the simple text book device which consists in adding to the possibility one-half of the annual increment. In actual practice the determination of the annual increment, is a task attended with serious difficulties, and the errors involved in its calculations render the possibility calculations to some extent unreliable. To obviate this difficulty the French forester evades the calculation of increment by omitting it entirely from possibility calculations on the plea that the error is made on the safe side, and that a low yield makes it possible to stretch the regeneration period without interrupting the sustained yield and thereby provides

against failures which are a common feature of the forests in which natural regeneration is depended upon. His Swiss confrère, however, not content with this apology for omitting the increment, depends for his figures for the increment upon the local yield tables which answer the purpose extremely well. Cases are not uncommon where a lengthy period necessitates the calculation of increment independently of yield tables and M. Biolley, who insists on the accuracy of his possibility to a fineness unknown in other forests, has perfected a system which involves the quinquennial measurement of his forests to enable him to ascertain the increment with the utmost accuracy.

Conditions in India, where thousands of acres of forests have to be dealt with, render separate calculations of increment for different localities impossible. Indeed, the attempt to calculate the increment for sal on the Swiss lines had to be abandoned this year in the United Provinces for it was found that the figures for the increment per cent. as obtained from the yield table for sal did not involve such errors as to justify extensive quinquennial measurements of large areas. It can be shown that the influence of any error introduced in the increment is so small on the actual possibility that the use of a yield table is quite justified. The following investigation of the relation of errors in the increment and the yield will serve to illustrate my point.

For the period a and increment per cent. x the possibility is given by the formula

$$P = \frac{V}{a} + \frac{Vx}{200} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where V is the volume of the old wood.

The relation between the percentage errors between these dimensions is given by the formula

$$\frac{\delta P}{P} = \frac{\delta V}{V} + \frac{\delta x}{x + \frac{200}{a}} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Now, putting the maximum increment per cent. of sal forests at 2·2 and the regeneration period at 30, we have

$$\frac{\delta P}{P} = \frac{\delta V}{V} + \frac{\delta x}{x} \cdot \tfrac{1}{4} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

or in other words,

The percentage error in the yield

= the percentage error in volume + ¼th the percentage error in the increment per cent.

Thus even if an error of so large a magnitude as 20 per cent. is introduced in the increment per cent. derived from a yield table its influence on the possibility will be 5 per cent. only. The 10-year period of revision of the U. P. Working Plans makes it possible to diminish still more the influence of errors in the increment on the possibility. Thus, for a 10-year period, the influence on the possibility of an error in the increment will be reduced from ¼th to 1/10th. It will be seen that when short periods are considered one can allow himself considerable latitude of error in the determination of increment, and the use of a yield table is quite justified, since even for as large an error as 30 per cent. in the increment, the error in the possibility would be about 3 per cent. only. And when it is remembered that the forest officer cannot guarantee the accuracy in the extraction of the annual yield beyond an error of ±10 per cent. it will be obvious that the maximum error of ±3 per cent. due to an error in the increment is permissible in the yield. Reference may also be made to the difficulties which the sal areas present in getting naturally regenerated. The French apology for the omission of the increment in possibility calculations will, therefore, commend itself to every working plan officer. But for those who must have the highest degree of accuracy in the extraction of the annual yield from the forests without securing a corresponding guarantee of their regeneration with the same exactitude, calculations of increment based on a yield table will be found to meet the highest possible demand for accuracy in the fixing of the possibility. Quite apart from the difficulties involved in the quinquennial measurements of extensive areas it may be stated that the calculation of volumes of large areas at given intervals for the determination of increment is not entirely free from errors, for the volume tables applied for the purpose may be as unsuitable to a particular locality as a yield table. In effect, the Swiss procedure if applied to the Indian conditions

will amount to relying more on the accuracy of volume table than that of a yield table both of which, however, may be equally inapplicable to a particular locality.

Cases, however, arise where the period for which the possibility is calculated is large and then it becomes important to ascertain the increment of the old wood with some degree of accuracy. The French Method of 1883 may be cited as an example where the possibility is calculated for a period equivalent to 1/3rd the rotation. The application of this method to the Indian forests is particularly to be recommended since the bulk of the so-called uniform forests are essentially selection and even for the uniform forests there does not appear to be any valid reason against employing this formula for the calculation of their possibility.

It is not necessary to go into the details of the French Method beyond indicating the broad outline of the procedure which it involves. After a forest has been enumerated between the limiting diameters corresponding to 1/3rd and 2/3rd the rotation age and the diameter corresponding to the rotation, the volume of the mid-wood and the old wood can be easily calculated by a reference to a volume table. The possibility is then obtained, if the proportions between the volume of the middle wood and the old wood are normal (3:5), by dividing the volume of the old wood by 1/3rd rotation and adding to it the increment for half that period *i.e*, for r/6 years. This involves the cumberous determination of the increment of the old wood before the yield can be prescribed and limits, therefore, the use of the method for possibility calculations. To get over the difficulties involved in the calculation of increment for the old wood, the following formula is proposed which automatically makes an allowance for the increment.*

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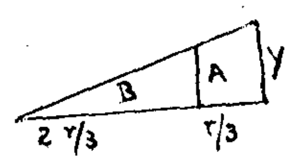
* The following outline will indicate the derivation of the formula :—

Volume of old wood A = Total Vol. — Vol. of B

$$V = \tfrac{1}{2}\,Yr - \frac{2}{9}\,Yr.$$

$$= \frac{5}{18}\,Yr.$$



$$Y = \frac{18}{5} \quad \frac{V}{r}.$$

where V is the volume of the old wood, r the rotation and Y the yield.

Objection can, however, be raised against the presupposition of the normal conditions in a forest which this formula necessarily implies. But it is possible to adjust the proportions of the volumes of the old and the middle wood in such a manner that the resulting figures would, for all intents and purposes, ensure normal conditions. In effect, this formula supposes that the actual increment of the old wood, which it seeks to eliminate is equal to its normal increment. That this is a perfectly valid supposition will be readily conceded when it is remembered that the adjustments between the mid-wood and the old wood, which the French Method necessitates according to definite normal proportions, secure normal conditions and the actual increment of the old wood can then be supposed to be equal to its normal increment without any appreciable errors. As a matter of fact the increment taken from a yield table would be also normal increment and not the actual increment, but this formula has this further advantage that it supposes the normal increment for a specific area to which a general yield table may be inapplicable. Again for species for which no yield tables have yet been constructed, the use of this formula would be a distinct advantage. Abbreviation of the possibility calculations, by dispensing with the increment altogether, may also be claimed as another advantage in favour of this formula.

An automatic allowance for the increment, it will be seen, removes a serious obstacle from possibility calculations. It should be remembered that the regeneration period for the Indian forest species is rather large which, coupled with the fact that there are no local yield tables, renders the determination of increment as important as it is difficult. Under the Indian forest conditions, where it is physically impossible to calculate the increment for different areas separately this formula, eliminating as it does the increment altogether, is well worth a trial.

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THE PROBLEM OF SAL REGENERATION.

In the *Indian Forester* of April 1926 a review was published of the latest Forest Administration Report in the United Provinces, which contained the following sentence:—

"It is certainly surprising that after so many years the problem of the natural regeneration of sal seems to be as far off as ever from solution."

There are many forest officers in the U. P. (I confess to being among the number) who disagree with this dictum, and consider that considerable knowledge (both positive and, equally important, negative) has been gained during the past ten years or so in solving the problem of *sal* regeneration. Two schools of thought have gradually evolved in the U. P., which for want of a better term we may label the pessimistic school and the optimistic school. The former hold the view so succinctly expressed by the reviewer in the *Indian Forester*; the object of these notes is to mention briefly the *facts* on which the optimistic school base their opposite opinion. The subject of *sal* regeneration may be considered under the following heads:—

I. Artificial—
   (1) by taungya,
   (2) by other means.
II. Natural—
   (1) how to start it,
   (2) how to get it established when started,
   (3) how to treat it when established.

I.—ARTIFICIAL REGENERATION.

(1) *By Taungya.*—Since 1920, it has been proved so conclusively that *sal* regeneration can be carried out successfully and with certainty by means of taungya (*e.g.*, in Gorakhpur and Gonda), that even the pessimists admit it. The only necessities for successful taungya appear to be—

(1) Willing cultivators.
(2) Protection from pig.
(3) Protection from frost.

Of these, the first is undoubtedly a very big limitation indeed.

(2) *By other means.*—Since 1920, it has been proved so conclusively that artificial sal regeneration cannot be carried out successfully and with certainty on a large scale by any other means than taungya (except at prohibitive cost) that even the optimists admit it. This is, however, very valuable *negative* knowledge, the recognition of which should in future prevent money being wasted that can be put to better uses.

II.—NATURAL REGENERATION.

(1) *How to start it*—So long ago as 1914, it was recognised (and in fact laid down in the Haldwani Division Working Plan) that departmental burning before a big seed year was very beneficial and induced masses of sal seedlings provided the rain came in time. So far as I know this view has never been refuted, but for some inexplicable reason this very sound prescription was never followed up until quite recently. I firmly believe, given (*a*) departmental burning in early April to remove leaf litter and reduce weed growth, (*b*) a big seed year such as we get every 3 to 5 years, (*c*) adequate and well distributed rain about the middle of June when the seed is falling, that in all good quality sal forests we can get sal seedlings, as a Ranger once reported, "in millions and billions." This year of grace 1926 should prove of great interest, since factors (*a*) and (*b*) for the first time in the recent history of the U.P. forests are universally present, and we can only hope that a kind fate will provide factor (*c*).

(2) *How to get sal seedlings established.*—We now come to the crux of the whole problem. The pessimists say we know nothing about it, that we do not know the factors that influence the establishment of sal seedlings, the period it takes, etc., etc. In fact, they have argued that our blank ignorance on the subject makes it unjustifiable to apply the uniform system to sal except on an experimental scale, since the acid test of the uniform system is to obtain established regeneration when and where we wish. They base their point of view on the admitted failure during the past ten years or so to obtain established sal regeneration in the P. B. I areas, which were usually the best quality and densest grown sal areas in the Division where the concentrated regeneration method was introduced.

(3) *How to deal with sal regeneration when established.*—This part of the problem is also conclusively and definitely solved. A clear felling (except for frost protection) cutting back to ground level everything down to the whippy stage and a good clean fire to dispose of the refuse and litter, positively ensures that the sal shoots go clean away, and beyond subsequent strict fire-protection, a little tending and climber cutting, require no further assistance until ready for the first thinning *in the 5th year.*

To put forward the opposite point of view of the optimists a few *definitely established facts* must first be recorded.

(1) Failure to obtain regeneration in P. B. I areas. As an illustration, I will quote the Lakhmanmandi block of Haldwani Division, a fairly dense sal forest approaching maturity of very fine quality, on Bhabar river gravels overlaid with deep loam. In 1913, a tremendous seed year, early rains, and a clean floor started sal seedlings from end to end of the regeneration area. The 1913 rains more or less failed, which so affected the overwood that hundreds of trees died, and for the next two or three years the leaf canopy was greatly reduced. Thus *despite* rigid fire-protection, the sal seedlings persisted. About 1916, however, the leaf canopy had begun to grow dense again, and with continued fire-protection a mass of weeds, *rohini*, Clerodendron, Sterculia, etc., had started, and shrub cutting was undertaken annually in the cold weather until 1919. In 1919, the whole area was still well stocked with sal regeneration about *1′ to 2′ high*, and from that time to the present day the area has been under continuous and detailed observation. It became at once evident that the sal regeneration was rapidly deteriorating, and that shrub cutting was not helping. It further became evident that the cause of deterioration was the poisonous growth conditions in the rains, *owing essentially to fire-protection.* In 1920-21 experimental plots of 25 acres were laid out to see the effect of (*i*) clear felling, (*ii*) shelterwood, (*iii*) strip felling, (*iv*) burning without felling. By 1922-23, *i.e.*, ten years from the bumper seed year of 1913, and ten years of rigid fire-protection, *the sal regeneration in the whole of Lakhmanmandi had absolutely disappeared* [except for

a very occasional plant, and in the burnt plot (*iv*).] The case of Lakhmanmandi has been quoted by way of example, and is corroborated by similar results in other parts of the province, and personally I consider it is conclusively proved that well stocked, good quality *fire-protected* sal forests will not and cannot regenerate.

(2) Referring again to Lakhmanmandi, the one area in the whole block which now shows abundant (but still quite small) regeneration is the 25 acres which has been burnt annually since 1920-21. The undergrowth has with five years of annual burning been converted from dense evergreen weeds and few sal seedlings to a large proportion of grass and sal seedlings.

(3) The finest virgin sal forests of Nepal are to be found on identical soil conditions (gravels overlaid by deep loam) as our best sal forests and these are burnt every year regularly. Mr. Collier who has seen and examined thousands of acres has recorded the fact that everywhere they are characterised by the abundance of *established* sal regeneration, light grass, and absence of clerodendron and evergreen weeds.

(4) It is an astonishing fact that sal areas in the Western Circle of the U. P. which now have abundance of young poles, saplings and advance growth, were *in every case* described in the old Working Plans as ruined and degraded by overfelling and *burning*, *e.g.*, the bulk of the Dehra Dun forests, and parts of Ramnagar and Haldwani Divisions. The Dehra Dun forests are specially striking in this respect. Fires came sweeping over the Siwaliks long after forest administration had organised the fellings. The only area in this Division where sal regeneration is seriously deficient is in the Thano block, the least accessible and most successfully fire-protected block in the Division.

Here are four definite established facts which cannot be denied and leave no scope for argument. They form the basis of the opinion held by the optimistic school which may be briefly summarised as follows :—

(1) that departmental or controlled burning is essential to start sal regeneration.

(2) that judicious felling and burning are essential to keep the regeneration when started.

(3) that the failure to obtain regeneration during the last 10 years (on which the pessimistic school lay such stress), was inevitable under the technique adopted, *i.e.*, fire-protection with little or no opening of the leaf canopy.

(4) that the establishment period is fairly long (probably at least 15 years), and anyone who expects established natural sal regeneration in a hurry will be disappointed. Natural sal seedlings do not, never have, and never will, shoot up quickly. But with the proper technique there are sufficient grounds to believe that the skill of the forester will be able to meet the acid test for the uniform method—to induce successful regeneration when and where it is required. It is impossible to claim that this is ***proved,*** we have been emancipated from the rigid fire-protection school for too short a period to prove anything yet. So recently as 1920-21, I wrote a note urging the abandonment of rigid fire-protection—or perhaps I should say urging the substitution of departmental burning, in all P.B.I areas of the Haldwani Division—and was snubbed for my pains! However, sanction was given to burn two compartments experimentally each year, which has been done, and these two particular compartments now show the best regeneration of all the P.B. I areas of the Division! To illustrate the degree of emancipation from the rigid fire-protection idea, I may add that this year sanction was obtained to burn the whole of P.B.I and half of P.B II (*i.e.*, 50 per cent. of the Working Circle), which was duly done. To avoid misunderstanding, I must make the point regarding fire-protection quite clear, otherwise we shall have some advocate of economy proposing the complete abandonment of fire-protection everywhere. Controlled burning is considered essential in all fairly moist and flat types of sal forest *in order to obtain established regeneration*, but having obtained it, rigid fire-protection is then essential in order to enable it to grow up into a well-stocked healthy sal forest. Similarly fire-protection is necessary in all dry or super-drained types of sal forest (*e.g.*, the Hill sal areas), to conserve the moisture and save the seedlings from dying of drought.

To summarise the points noted above, WE KNOW THAT :—

(1) artificial sal regeneration can be obtained on a large

scale and at moderate cost by taungya ***and by no other means.***

(2) natural sal regeneration can be started wholesale in any big seed year when the rain comes in time, by controlled burning immediately after the leaf fall.

(3) established sal regeneration can be induced to grow up immediately and form an established crop in the shortest possible time by clear felling or nearly clear felling, cutting back all advance growth, burning in March, and strict fire-protection subsequently.

(4) dense good quality sal forests of the moist type cannot be regenerated with strict fire-protection.

WE BELIEVE THAT :—

(5) Good quality sal forests can be regenerated within a reasonable time by controlled burning and judicious opening of the canopy.

Of these five important points, ten years ago only No. 2 was recognised, but seldom acted on, and No. 3 was partially recognised but scarcely ever acted on, while Nos. 1, 4 and 5 were not recognised at all.

Is it true to say (as the Forest Administration Report and the review thereon has said) that no progress has been made in solving the problem of sal regeneration? It seems to me, and to several other foresters who have been in closest contact with the problem, that progress in solving it has been very considerable.

E. A. SMYTHIES, I.F.S.

RATS IN THE BELFRY OR JUSTIFYING HIS EXISTENCE.

When the Imperial Silviculturist sent a chit round to the Forest *Zoologist* intimating that rats were taking an unpleasing interest in his chir and sal seedlings in the Demonstration Area at Kaulagarh, the New Site, and what were we going to do about it, it was politely pointed out in reply that the *Entomologist* was not supposed to know anything about rats, did not in fact know anything about rats, and did not want to know anything about rats.

It was suggested, though, that, if he could think of nothing better the Silviculturist should *try salt on their tails*. *When, however,* the Silviculturist completely ignoring this polite note, proclaimed in a public place that the ......ologist was refusing a chance to justify his post at last, it was felt that the insult could not be taken *lying down and that the challenge must be accepted.*

The scene of operations was, therefore, visited and the enemy's earthworks reconnoitred.

The territory invaded is an area of about 230 acres, which *has been set aside for the Silviculturist to play with, and of which* he has so far stocked about 30 acres with chir, 9 with sal, 9 with *Dalbergia latifolia* and 8 with *Gmelina arborea.* The remainder of the area is at present let out to cultivation, the crops on the ground at the time being chiefly wheat and gram. The northern portion, which was the more heavily invaded by the rats, slopes gently towards the south-west, and has in consequence been laid out in broad terraces for purposes of cultivation. The bunds forming the edges of these terraces were admirably suited to the rats as bases from which to sap out into the fields both above and below, and everywhere there were large mounds of earth like enormous mole-hills, as evidence of the underground activity. It was these mounds that had raised the Silviculturist's ire, as not being particularly impressed with the sanctity of chir pine seedlings, the rats had erected their mounds *on* the lines or between the lines indifferently. The lines had thus ceased to be lines and the seedlings to be embryo "dominants" or "suppresseds," and as a potential object of Silvicultural instruction to a coming generation of students, the thing was a failure—thinnings carried out a decade too soon!

In the sal area, too, several likely looking seedlings had suddenly and mysteriously withered, and when pulled up were found to have no roots. Not even the Imperial Silviculturist, of course, can *grow a tree without roots, so it was a very serious matter.*

Having thus seen what we had let ourselves in for the next thing to do was to read up something about rodents and how to deal with them. It was realised, of course, that they could be got rid of by fumigation with carbon *bisulphide or hydrocyanic*

acid, but something simpler was desired, as a start anyway. A little research into the literature on the subject revealed the fact that barium was toxic to rats, if they could be got to eat it, of course. So it was decided to try them on a course of barium carbonate, made up into attractive-looking pills with dough of ordinary atta. The formula used was as follows :—

Barium Carbonate	...	... $1\frac{1}{2}$ lbs.
Wheat flour ...	...	... 4 „

(to be mixed thoroughly with the addition of pure water to make into a fairly firm mass. The mass is to be divided into 3,500 round baits of uniform size, so that each bait will contain approximately 3 grains of Barium Carbonate).

It was, however, thought advisable that before introducing the rats to the poisoned baits, their confidence should first be gained with nice, freshly prepared unpoisoned baits. Then, when these were disappearing freely, the idea was to lay the poisoned baits, and catch them before they had learned wisdom.

This idea was satisfactorily put into practice, and after three or four days over 90 per cent. of the unpoisoned baits were being taken. Then poisoned baits were laid over the whole area that had been covered by the "free meals"—with, on first sight, most indifferent results! But in an effort to give the rat every chance of finding and consuming their poisoned meal baits had been laid at every possible, and sometimes impossible, place. At least half had been placed on the top of the 'mole-hills,' there being no hole to put them at, and of these only 28, a minute proportion, had been found and eaten. These must have been found just by chance, by rats wandering around over the surface. About two-thirds of the remainder had been placed at what looked like old, blocked-up holes: their appearance was apparently justified, for very few of these either had disappeared. The remainder, which had been laid at open holes, had nearly all gone. So, although much could not be hoped of a second baiting in the same area immediately after the first, baits were laid the next day only at what were taken to be holes in use, *i.e.*, open, and often with fresh earth round the mouth. Sixty per cent were taken. The Forest Guard's Chauki, alongside the area under

treatment, and which he said was over-run with rats, was also treated. 25 poisoned baits were removed within 20 minutes, and out of a further 23 put down immediately only 7 were left an hour or so later. That night the man was not troubled at all nor has he been since.

The rats were then given a rest for a week, and the process repeated, both over the area already treated and also over the remaining planted area (*Gmelina* and *Dalbergia*). In the latter area the damage by the rats was not so apparent. Very few mounds had been thrown up, but a number of holes were to be seen, and it was thought that the rats were just entering the area, and had not yet got to the stage of erecting mounds all over the place. This opinion was subsequently found to be mistaken, and that it was another species of rat. Both these areas were treated as before, "free meals" for several days and then a course of poison.

Judging by the percentage of poisoned baits taken, from 70 per cent. to 95 per cent., the treatment was entirely satisfactory. There is no doubt of the efficacy of the poison, as several dead rats were picked up, and their stomach contents showed on analysis a large excess of barium. There has been very little fresh work of the rats since, and though this is undoubtedly due in part to a reduction of their food supply, we lay claim to having definitely killed a large number, and seriously inconvenienced the remainder.

With regard to the food supply, the area treated, particularly that sown with chir pine, had been very heavily clothed with weeds, principally various species of wild Vetch, and a tall, fleshy weed, known locally as "Sirauli" (*Celosia argentea* Linn.) which forms a silvery inflorescence containing, when mature, large numbers of shining black seeds. Both the Vetches and this "Sirauli" were favourite foods of the rats and could be removed in handfulls from their burrows. The Silviculturist was, therefore, recommended to have the area cleared of these weeds, and this, combined with the clearing of bushes and long grass from the bunds, has certainly assisted in bringing about the desired result, the disappearance of the rats.

This disappearance is not likely to be more than temporary. As long as cultivation, particularly of gram and millets, goes on there are sure to be thousands of rats hanging about seeking what they may devour, and during the periods that crops are not available they will partake of the Silviculturist's weeds, and at the same time, though unwittingly, of his chir pine and sal seedings. As, however, the *Entomologist* undertook this work merely to justify his existence, which he feels he has now done, he does not propose to make himself responsible for the permanent protection of the Silviculturist's toys. The latter's myrmidons have been instructed in the preparation and disposal of the poisoned baits, and on his own head be future visitations!

It may be of interest to note that the name of the cause of all the Silviculturist's troubles is *Gunomys bengalensis*, Gray and Hardw., the Indian Mole rat. His companion in iniquity was *Tatera indica* Hardw., the Indian Gerbille, the species referred to as found in the *Gmelina* area, without "mole-hills." A dead *Rattus rattus rufescens* Gray, and an equally dead *Leggada buduga* Gray also were picked up, so perhaps the Silviculturist really had something to worry about. By the way, who would recognise these two last as being the Indian House Rat and the Field Mouse respectively?

CONTROL OF TRADE FELLINGS IN BURMA.

Before starting to discuss control, it will be as well to review the existing methods in use in Burma. I propose to deal only with the local trader, that is the man, who by license or purchase contract, extracts mainly from Unclassed Forest some two hundred to one thousand tons of timber a year.

The petty 5 to 10 ton licensee and the big firm present rather different problems; as extraction by the former is too spasmodic for stump marking while extraction by the latter is controlled by long term leases.

My remarks are based on experience confined to the type of Division not under Working Plans where the bulk of the revenue comes from Unclassed Forests while the bulk of the expenditure, and therefore, the time of the Divisional Officer and

his school trained Rangers, is spent in the reserves that are being prepared for the exploitation of the future.

Having now defined the limits of the enquiry, let us examine the prevailing method, which is Bank or Depôt Delivery.

The system may be found in four stages of development :—

1. *Uncontrolled issue of post-paid licenses.*—This method is, I believe, now moribund and consists of the issue of unlimited licenses to all comers. The only control was that the license fixed a minimum girth below which no tree may be felled, a maximum volume that may be extracted in a fixed period and, as a marking and measuring place, some stream bank or Railway Station often miles from the felling site.
2. *Uncontrolled issue of Pre-paid licenses.*—This method is the same as above except that, as licenses are prepaid, the Divisional Office has the additional work on expiry of the license, of either refunding the duty on the unextracted balance or transferring it to a new license.
3. *Restricted issue of Pre-paid licenses.*—Here we have the first signs of control in that the number of traders in any given beat and the number of current licenses held by any one trader is limited.
4. *Selection marking of all trees before issue of licenses.*—This system permits of the total number of licenses to be issued in any one area being limited to the estimated tonnage of trees marked and of the division of the beat into blocks, one for each trader.

We will now examine what happens under each stage. Under 1 and 2 an uncontrolled swarm of traders rush their fellers to the richest patch of forest, where each gang fells and hammers as many trees as possible—if it is a distant beat the hammering is dispensed with till the logs get near the measuring place. The cartmen then log as suits them best (giving due consideration to what makes a paying load but no consideration to anything else) and leaving in the jungle a mass of waste tops and rejected logs—rejected often because they made a bad cart load not because they were unmarketable.

Under the third phase the confusion is slightly controlled and under the fourth you do at least know who has committed the waste or can anyway attempt to father all hammerless stumps and tops on to the Block holder.

But under none of these four systems do you get any nearer control of logging and felling *WHILE IT IS IN PROGRESS!* The best you can hope for is a crop of forest offences *AFTER* the license has expired. At this stage I shall, no doubt, be asked what my Revenue Assistant and Beat Officers are doing. The former, if he exists at all, will be fully occupied issuing and extending licenses, bills and removal passes; checking the revenue marker's work at Railway Station or stream bank, and will have little or no time for visiting felling sites; while the Beat Officer, being poorly paid and human, will endeavour, by only inspecting and reporting on completed licenses, to show that he is a hard working officer without enraging the traders. In other words, the staff, in spite of theory, is concentrated on collecting revenue on timber actually extracted and on inspecting work *after* extraction is finished.

A further point against measuring after extraction—and this applies especially to measuring at Railway Stations—is that, as all the timber is dumped on to Railway land over which we have no control, it is impossible to get any systematic grouping of the logs and consequently measurement and check are made very difficult.

Having now reviewed the existing methods and tried to prove that they are ineffectual to control :—

(*i*) felling and logging while in progress,

(*ii*) systematic working over coupes,

(*iii*) efficient inspection by subordinates

(*iv*) prevention of wasteful extraction,

I will describe a method of control which may be called stump marking.

I define stump marking as "control of extraction by the allotment for a lump sum felling fee, in addition to Royalty, of definite Blocks of marked trees wherein no log shall be moved rom stump until it has been measured and duty marked."

For stump marking to be a success, it is essential that—

(1) each contractor shall have a definite area containing a definite number of marked and numbered trees,

(2) that he shall fell all trees systematically without selection,

(3) that there shall be a Revenue Marker and peon available for every 1,000—1,500 trees to be felled,

(4) that the Revenue Marker shall be in possession of the original note book in which numbers and girths of all marked trees are recorded,

(5) that as well as preparing the usual bills and impressing the usual numbers and hammer marks on logs, he shall enter all logs measured opposite their correct trees in the note book and shall impress the serial number of each log on the face of the stump concerned,

(6) that he shall not measure until trees have been logged as well as felled and shall at that time assess and mark for duty all wastage due to bad logging.

It is maintained that this system is practically fool proof and has the following advantages over uncontrolled issue of bank delivery licenses :—

(1) By allotting a definite block of numbered trees to one trader you know who is responsible for illicit fellings ;

(2) by insisting on systematic felling, you get your block cleared once for all instead of having licensees picking and choosing for years ;

(3) that with an adequate staff of Revenue Markers, you are bound to have proper check of fellings and logging while in progress ; as if the Revenue Marker does not duty mark logs as they are logged, the trader at once complains to a higher authority : whereas under bank delivery it is to the traders' interest that the Beat Officer should not visit the area until the license has expired ;

(4) that any officer any time until the rains, can, with the note book and the log numbers on stumps, check the Revenue Marker's work in the forest, this being in addition to the measurement statement checked by remeasurement of logs on bank under the old system.

I have personally found one Revenue Marker guilty of fraud merely by checking stump girths and sawdust marks with the *lengths and girths recorded in the measurement statement. Thus* if a 7′ stump with 40′ from butt mark to the rejected top shows in the measurement statement records 1 log, 4′6″ girth by 25′, there is something wrong.

This fraud could not have been detected under any of the old systems, unless the log happened by bad luck to be among the very small percentage of logs in Depôts which are rechecked by Divisional Forest Officer or Revenue Assistant.

(5) That by assessing wastefully logged tops for Royalty on the spot, the traders rapidly learn what is officially considered to be marketable, as opposed to what they think will yield a big profit and be convenient to extract.

I will admit here that stump marking rather grinds the trader, who is usually only an extracting agency and not a miller, between the official definition of marketable on the one hand and the nether millstone of the millers' arbitrarily fixed prices on the other; but as it is obvious that we cannot for ever allow traders to log each tree to yield only one profitable log and waste the rest, and as it is also clear that Bank delivery never educated anyone's ideas of logging, it would seem that the only hope of killing the millers' prejudice for certain lengths is for us to squeeze the trader and leave him to starve the miller into a more reasonable frame of mind.

To summarise under stump marking :—

(*i*) You have definite men working definite areas, holding definite numbers of marked trees.

(*ii*) You have guaranteed inspection of fellings *in progress* and checking of waste *during work*.

(*iii*) And you will ultimately have a reduced and concentrated staff doing its proper duty of controlling work *in situ* rather than as at present a large and expensive net work of Beat Officers attempting to check your chickens, after the stable door has been left open !

As an example of the immediate gain to Government, I can quote one block where 300 trees yielded under stump marking

550 logs and tops cubing 412 tons of which the trader admitted that 109 tops cubing 16 tons or 4 per cent. would never have seen the light of any depôt under the old systems.

"MARANA."

EXTRACTS.

CONCESSION LEASE OF BAMBOO FORESTS, ANGUL DIVISION.

GOVERNMENT OF BIHAR AND ORISSA.

REVENUE DEPARTMENT.

NOTICE.

The Government of Bihar and Orissa wish to be known that they are prepared to grant a concession over the bamboo forests of the Angul Forest Division to any approved firm, company or other applicant requiring bamboos for the purpose of manufacturing paper-pulp. The lessee would be required to enter into an agreement with Government which, *inter alia*, would include the following terms :—

(*a*) *Period of the concession.*—The lease would run for thirty years, with the option of renewal for a similar period.

(*b*) *Royalty.*—A preferential rate of royalty would be allowed. On Salia bamboos (*Dendrocalamus strictus*) the rate would be four annas per 100 bamboos and on Daba bamboos (*Bambusa arundinacea*) the rate would be one anna per hundred bamboos. The rate would be liable to revision after the first fifteen years of the lease, but the revised rate would not exceed double the rate of royalty payable during the first fifteen years. If the lease were to be renewed for a second period of thirty years, the rate of royalty would not exceed double the rate of royalty payable during the second fifteen years of the original lease.

(*c*) *Minimum royalty.*—No minimum royalty would be payable during the first three years of the lease. It would then be imposed on a progressive scale rising from Rs. 1,500 in the fourth year to Rs. 7,500 in the seventh and subsequent years of the lease.

(*d*) The lessee would be required to establish a mill for the manufacture of paper-pulp at Cuttack with a capacity of manufacturing not less than 5,000 tons of air dry pulp per annum. The lease would prescribe the dates within which the lessee would be required to form a company (if not already formed) and to place orders for machinery. The lessee would be required to complete the factory within three years from the date of the lease.

(*e*) The lease would be for 15,000 tons of green bamboo per annum to be removed from the forests by the lessee, who would be given the option of taking out a lease for any further quantity within the existing capacity of the forests and subject to the requirements of the local trade.

(*f*) The lessee would enjoy a monopoly for the first ten years of his lease, subject to the requirements of the local trade.

(*g*) For the first thirty years of his lease the lessee would *bind himself not to obtain* bamboos for use in his factory to be established at Cuttack from any other source without the permission of Government.

(*h*) The lessee would bind himself to use the bamboos extracted under the lease solely for the purpose of paper-pulp manufacture in his factory to be established at Cuttack, unless any departure from this restriction is permitted by the Conservator of Forests on a formal application.

(*i*) The lessee would be subject to the ordinary rules of the Forest Department.

(*i*) *Security Deposit.*—The lessee would be required to make an initial deposit of Rs. 5,000, which would be liable to forfeiture in the event of Government being dissatisfied with his progress or on any serious breach of the conditions of the lease.

2. Information on the subject of the bamboo forests of the ower Mahanadi basin (and in particular of the Angul forests

and of the possibility of their utilization for paper-pulp manufacture has been made public in reports written by Mr. J. W. Nicholson, Deputy Conservator of Forests, and by Mr. W. Raitt of the Forest Research Institute at Dehra Dun. Copies of these reports can be obtained on application to the Conservator of Forests.

3. Tenders are invited and should be addressed to the Conservator of Forests, Bihar and Orissa (at Ranchi). Applications received by him on or before the 31st July 1926 will be duly considered.

RANCHI: W. H. LEWIS,

The 13th May 1926. *Offg. Secretary to Government.*

CINCHONA IN BURMA.

Extract from the Report of the Botanical Survey of India for the year 1924-25, by C. C. Calder, Director.

A further year's experience of Cinchona in Burma emphasises the truth of the statement that one seldom dreads what in the event is most to be feared but is ever apprehensive of what seldom materialises. A very anxious time during which the future of Cinchona in Burma hung in the balance was experienced towards the end of the rainy season of 1924. A collar disease exhibiting symptoms of canker made itself alarmingly evident with the progress of the rains by causing a mortality estimated at 18 per cent. over an area of very promising Cinchona put on when operations were first started. The trouble is first made evident by a flagging of the whole plant from its crown downwards and by a thickening, darkening and longitudinal cracking of the bark at ground level and a few inches above. The general effect so much resembles fungoid action that it was considered desirable to get the Imperial Mycologist to Mergui to investigate the disease on the spot. In spite of repeated attempts with ample material to work upon no fungus capable of producing such an effect could be isolated, no culture from affected

parts would develop in media and microscopic examination too failed to reveal the presence of organic growth. Had the tests been made with scanty material or on plants at one stage of collapse doubt might have remained as to whether a fungus was the cause but the negative result was too persistent and attention had to be turned to causes other than fungoid for the trouble. While the sides of ridges were not free of the condition, Cinchona in a state of collapse was much more in evidence on the flat damp wind swept crests. The effect produced indicated the advisability of an improved system of drainage and care at the time of planting and hoeing, for as no specific disease could be found there was the strong possibility of something wrong with the system of cultivation. A set of careful observations made by Mr. Russell during the rainy season just passed supports the theory that the collar thickening and collapse is a physiological effect of deep planting combined with wind action which creates a local water-logging at the base of the stem. With the swaying of the young plants on the wind swept crests a hollow cone shaped depression, smooth and capable of retaining water for a considerable time, forms at the collar. Mr. Russell's observations go to show that the collapsed condition is seldom found in plants which have their root system almost on the surface and the collar completely free of earth. The prevention of the trouble probably lies in an improved drainage system, shallow planting and the removal at hoeing time of all earth from about the base of plant. The present year shows a very marked improvement over the affected area as regards this unhealthy condition. The percentage of sickly plants has been reduced to an almost negligible quantity and another distinct advance recorded in the experimental cultivation of Cinchona under these new conditions. In order to minimise the effect of the high winds experienced, belts of natural jungle will in future be left across the main directions of the storms to act as wind breaks.

The appearance of Cinchona at the end of the year under review left little to be desired. Plants three years old were already eight feet high and had developed in proportion to an extent that made it a matter of difficulty to push one's way

between the branches of neighbouring trees. This is a condition that one would be glad to have in trees of double the age in the Bengal plantations. The entire absence of *Helopeltis*, the scourge of Cinchona in Bengal, from the Mergui area was scarcely to be expected. The insect has a wide distribution and it would have been a matter for wonder had it failed to appear in the new area. During the year it did appear and at times became troublesome but the rapidity with which growth is made counteracted its effects and it was never really serious.

No large or representative analysis of barks was carried out, a check on alkaloid content being done only on the bark of trees that had on account of sickness to be taken out. The results obtained with these were in accordance with early analyses and go to show that a high grade bark is to be expected as the trees mature.

Labour conditions during the year left much to be desired. Labour was not too plentiful and an attempt made through business agency to recruit coolies from South India towards the end of the year was largely a failure. If the area of Cinchona laid down as necessary for planting yearly is to be maintained and the area already out kept in proper cultivation, some help other than the mere granting of money for coolie recruitment will be necessary. A successful year in the rubber and mining industries has made labour, at all times, difficult to obtain for pioneer work, scarce and shy of engaging for Cinchona Camp and it may be necessary in the near future for the Government agency that controls recruitment to earmark a certain proportion of the labour available for Cinchona purposes.

The history of Cinchona during the year provides much cause for encouragement and points the way in several directions to further effort. The scheme must still be considered as experimental but there is much more evidence now than there was even a year ago to indicate that the experiment will end successfully and that a prosperous industry may result. The most pressing difficulty is associated with the supply of labour for as the plantations increase an evergrowing labour force is an indispens-

able necessity. While it may not be easy to get labour for opening up and maintaining even a few hundred acres the difficulties are immensely increased when the hundreds approach the thousand mark. They are further increased by a growing knowledge amongst labourers ready for recruitment that the work required of them is of a rough, heavy, pioneering kind and that the estate they are wanted for is remote in an unopened and largely uninhabited jungle. It is at this stage of developments essential to take every possible care of the labour secured and to see to it that a good name for the estate filters back to recruiting areas, for it is more evident now than it was at the beginning of operations that one essential for success lies in a plentiful and contented labour force. Given this force and a continued freedom from disease, I see no reason why a large Quinine producing belt extending from the Tenasserim River eastward to the borders of Siam should not result, and production on a scale sufficient to affect controlled prices, and bring the drug within the reach of India's malarial millions.

INDIAN FOREST SERVICE.

A *Daily Telegraph* correspondent writes :—

The report of the Forest Department of the Jammu-Kashmir State for the Hindi year 1981 (1924-25) shows the fine results of systematic management under officers of the Imperial Indian Forest Service lent by the Government of India. These officers have only been in charge since 1891 (34 years) yet in that comparatively short time they have raised the yearly revenue from the forests to something not far short of half a million sterling. In 1890, when the forests were managed by State forest officers, the gross revenue was about £22,000 per annum, and the net surplus, or profit was probably not more than £10,000, while for the year 1924-25 it was about £250,000. This is the result of scientific management, under Government of India officers, by a permanent forest staff, sure of promotion and a pension at the end of their service. Under the old native régime no forests had

been demarcated or surveyed. Now the area under the Forest Department is estimated at 9,550 square miles, equal to six million acres; of this 9,312 square miles have been demarcated, and 587,000 acres (917 square miles) have been surveyed.

The greater part of the revenue is derived from the sale of timber in the log and railway sleepers, but there is also a large income from what are called "Minor forest products." These consist of the root of a plant, saussurea lappa, known locally as 'kuth,' a very valuable aromatic root which is mostly exported to China. Other products are crude resin from pine trees, extract of the berberis shrub, belladonna, bamboos, wild violets, roots of podophyllum, bark of the birch tree, various medicinal plants and lac. In former times the income from these sources did not exceed Rs. 50,000 per annum; now the value of the produce has risen to Rs. 2,163,335, and the sales to the public amounted to Rs. 1,114,273. Apart from the great increase of revenue from the forests there is the inestimable gain that they are now properly managed, and that most of the old destructive practices that were slowly ruining them have ceased. This is the position in one only of the native States of India.

To turn to the Government forests in British India, the records of the Forest administration show that up to the end of 1869 the yearly net surplus amounted to Rs. 1,300,000; at the end of the century it had risen to Rs. 8,000,000 per annum, and by the end of 1923-24 to Rs. 18,400,000. This is the result of having a permanent Imperial Forest Service eligible for promotion and pension.

What is the state of affairs in the United Kingdom? There has never been a permanent Forest Department as in other countries, and in consequence no continuity of work. The result has been that there are not more than 200,000 acres under the Forestry Commission, very little of which is mature forest. It is not too much to say that had Britain done as India did some 65 years ago there would have been a fair stock of timber available for war purposes, and most of the £70,000,000 paid to foreign

countries for their timber would have been kept at home. In Finland it would appear that some measure of conservation and management has been carried out for so long as 300 years, while it is well known that Germany and France have long had a permanent forest department.—[*The Timber News.*]

PROTECTION OF THE FAUNA IN BURMA.

The increase in the areas under cultivation has yearly led to increased harassment of the wild life of the province. Except against wild elephants the cultivator has hitherto been well able to hold his own with his own weapons. The relaxation of the rules regarding the issue of gun licenses has put him in a position to exterminate the wild life and this is what is taking place in many places. Inhabitants of the plains and foot-hills such as hogdeer and brow antlered deer have already been driven out of existence in many localities and unless measures are taken for their protection they will soon be on the verge of extermination throughout the Province. The Bos sondaicus will soon be in a similar plight. Denizens of the hills such as bison and sambhur will fare better but unless some control in the issue and use of guns is evolved their extermination is merely a matter of time. Elephants should be a material direct asset to the country. At present they are so numerous as to be a nuisance in many cases; but a continuance of the indiscriminate issue of licenses to kill or capture them will before many years reduce their number to vanishing point.

The necessary legislation for protection has been in existence for years; but in most cases it has been a dead letter. There has been no central authority directly responsible for its enforcement and officials have had so many claims on their time that unless they were personally interested nothing was done. In fact it is mainly owing to the personal interest taken in the matter by His Excellency Sir Harcourt Butler, G.C.I.E., K.C.S.I., that the position of the fauna is not much worse than it is at present.

The subject was considered during the year at the conference of Commissioners, the conference of Conservators and a special Committee held in Rangoon. Various suggestions are before Government of which the most important—in fact the key suggestion—is that an officer should be appointed as Game Warden to co-ordinate and control the efforts at protection. The post of Game Warden is absolutely essential if anything useful is to be done towards protection and there is reason to hope that it will be sanctioned. Even this appointment will be of little use unless it is possible to stimulate a general interest in the matter and create a healthy public opinion in favour of giving the harmless members of the fauna a reasonable chance to survive. It will be a reproach to the present generation and an irretrievable loss to future generations if no practical measures are undertaken to stem the destruction of the wild life of the province.—[*Report on Forest Administration in Burma for* 1924-25.]

THE BOMBAY NATURAL HISTORY SOCIETY

Since its establishment over forty years ago the Bombay Natural History has carried out an enormous amount of valuable research work and has done a great deal to popularise all branches of nature study in this country. Sir Reginald Spence, at the annual meeting held this week, pointed out that the Society was continuing its admirable work under some difficulty owing to the fall in membership. Before the War the total number of members was nearly 2,000. There were many losses during the war, and trade depression has been responsible for these not having been made good. The membership at present stands at 1,234, which is 50 less than a year ago. This reduction is the more serious as since the withdrawal of the annual grant of Rs. 5,000 from the Government the Society has become more dependent than before on the subscriptions of members for its existence. It is to be hoped, therefore, that there will be an early response to the appeal which has been made for the further recruits and funds which the Society needs and so thoroughly deserves. Sir Reginald Spence made a

number of interesting announcements at the annual meeting. The present year, he stated, would see the conclusion of Mr. T. R. D. Bell's important work on the common butterflies of the plains of India which was commenced in 1905. The sorting out of the vast amount of material obtained during the Society's annual survey of India, Burma and Ceylon, which includes some 20,000 specimens, is still proceeding at the British Museum, and the result of the work is promised in a new volume in the "Fauna of British India" series which has been sanctioned by the Secretary of State. On completion of the work the specimens obtained during the survey will be available for distribution among various museums in India and abroad.—[*The Pioneer.*]

INDIAN TEAK SUPREME.

Extract from article on "Empire Timber" in the "Timber News" dated 1st May 1926.

Indian Teak Supreme.—Indian Teak stands supreme in the United Kingdom and other countries for heavy work. Among other high-class British Indian woods on the British market are rosewood, which is in demand for piano cases and furniture, satinwood, Burma mahogany, which is reported to have been preferred for high-class work, in a recent instance, to Honduras or Spanish mahogany, ebony, white mahogany, Andaman padauk or ironwood, gurjun, claimed to be stronger than English oak, pyinma, pyinkado, East India walnut, and silver greywood, all of which are gradually finding progressive markets in Great Britain.

There are said to be 2,500 indigenous species of trees in India, and its timber resources are enormous. Here, again, the trade with the United Kingdom and the Continent is handicapped by the high freight costs, but in spite of this drawback it will undoubtedly expand within the next few years, especially if the beauties and qualities of Indian woods continue to be brought forcefully before the notice of merchants and consumers.

WATER HYACINTH.

Further experimental work done in Bengal to determine the effect of sprays on the water hyacinth has demonstrated that Griffith's spray is effective in killing 75 to 90 per cent. of the plants in a treated area, and that spraying is less expensive than man-handling. The spray being a poison there is, however, some danger in using it in areas adjacent to dense centres of population. The results of a series of experiments at the Institute of Plant Industry, Indore, on the conversion of a water weed into finely divided organic matter suitable for the cotton crop, have induced Mr. Howard to suggest that the water hyacinth should no longer be regarded as a pest to be destroyed, but should be converted into valuable manure for jute and rice by means of the Chinese methods of composting crop residues.—[*Review of Agricultural Operations in India*, 1924-25.]

THE TIMBERS OF INDIA AND BURMA.

DEAR SIR,—The issue of January 16th contained a letter from your pseudonymous correspondent "Woodlander," relating in a general way to the timbers of India and Burma and, in a more particular way, to myself.

I read the letter at the time, but it had not occurred to me that any reply was called for till it was suggested that the writer might be disappointed if his carefully prepared piece of work should pass entirely unnoticed.

The letter is lengthy, but my reply can be brief. It simply is that, after carefully studying "Woodlander's" observations, I find nothing in the letter to lead me to alter, or reconsider, or doubt the accuracy of, any single thing in the lecture which he criticises.

The substantial matter of the letter being disposed of in this way, there is really no need for me to say anything further, as whatever remains is more or less in the way of being amusing at my expense. I do not mind that sort of thing; in fact, I rather like it, especially when the writer, as just occasionally happens, succeeds in making his little point quite prettily; but I am too busy a man to be much good at this sort of work myself. At the same time, it hardly seems courteous to leave the matter on this

flat disagreement on the main issue between your correspondent and myself, especially when I see that there are minor points on which we can probably be reconciled, and I will endeavour to work out one or two of these.

I quote the following words from the letter :—

> Mr. Howard has been harping vaguely on what he now refers to as those marvellous stores of wonderful timber in Burma and India, but he has not yet told us what precisely these marvellous timbers are, nor where exactly the wonderful stores of them exist.

This would seem to suggest either that these stores of wonderful timber exist only in my imagination, or else that it is up to me to prove their actual existence. Now, my secretary, who has *an excellent filing system, has promptly produced and placed* before me what would appear to be a complete ready made answer. Here are the words :—

> There are, of course, available in the forests of Burma enormous stocks of valuable but little known woods, which should be advertised and put on the market.

It might very well be supposed that these words had been written by myself in my best public style, but who would ever have guessed that they actually appeared in a letter by "Woodlander" himself in your Journal of March 7th last year ?

So it appears that "Woodlander" and I are really entirely agreed as to the actual existence of these valuable woods. Still better, his opinion that they "should be advertised and put on the market" seems to afford an opening for a futher happy agreement between us, which I will next endeavour to develop.

That phrase "harping vaguely" rather appeals to me, although it is hardly a complete description of the strenuous labours connected with the "advertising and putting on the market" of these "valuable woods," which has been my special and unceasing occupation for several years past.

I invite your correspondent's particular attention to the last part of the last sentence, because (although he appears to follow my sayings and doings with a certain amount of anxious interest) it would really seem possible that he may never have visited the

Forestry and Timber Courts in the India and Burma Pavilions at the British Empire Exhibition, and that he may never have seen the exhibitions of furniture, panelling, fittings, staircases, floorings, etc., and especially the shops in the centre of the Burma Pavilion with their fittings, and the great variety of works in wood of all new kinds, nor seen those Pullman cars, or the Express lift, both of which were in the Engineering Section, nor the Boat Pavilion adjoining the India Pavilion, and many other things, all of these being made from the woods in question.

It also seems unlikely that he can have read the report of the Dewan Bahadur, now Sir T. Vijayaraghavacharya to the Government of India, nor the report by Professor Troup, which is included therein, in which my work in connection with the establishment and arrangement of the Timber Exhibits is spoken of in terms of no measured praise.

I can assure you, Sir, that at the time I found all this to be a real, hard, workingman's job, but now that it is over I am content to look back on the time and labour and anxiety which were expended, and to employ this moment of rest in "harping vaguely" (as I am now deliberately doing) on the results attained —*not without, I admit, a certain feeling of self-satisfaction.*

I am pleased to be able to oblige "Woodlander" by playing the part which he has assigned to me, thus giving reality to his pretty phrase; while at the same time I have been able to indicate quite an active interest on my part in the advertising and marketing processes which he considers desirable. In this way we seem to arrive at a further very happy understanding.

I might attempt to develop a few more points, but I fancy Sir, that you may consider this to be enough, and I thank you for the courteous hospitality of your columns.

ALEXANDER L. HOWARD,
38, Trinity Square,
London, E.C. 3.

January 26th, 1926.

[*Timber Trades Journal.*]

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THE WORLD'S FORESTRY CONGRESS OF 1926.

The Congress held at Rome this year to discuss forestry questions was an event of considerable importance and fraught with possibilities for the future : provided, always, that its conclusions are given the serious consideration they merit at the hands of the various Governments responsible for the correct conservation and maintenance of the important forest tracts within their charge. Fifty eight Nations were represented by Government delegates varying in number from one to five and by other representatives with or without a vote. Some of the European Governments, as also the United States of America, had very strong delegations and this proved a decided advantage, as will be shown. The representation of India was rather weak. Lord Lovat and Professor Stebbing were the respective heads of the delegations of Great Britain and India. Including the delegates about 900 persons are said to have attended the Congress, which assembled in Rome on April 28th, the dates of meetings being between April 29th and May 5th. The arrival at Rome was preceded by a visit to the Milan Exhibition where an official inspection of the forestry exhibit was arranged for April 27th, including a section dealing with wood-working machinery. Although of interest there was nothing particularly new in either of the sections. Messrs. Pearson and Trotter endorsed this opinion with reference to the machinery.

On the 28th a meeting of the Technical and Scientific Committee of the Congress was held in the afternoon at Rome. At this meeting the various Honorary Presidents, President, and Vice-Presidents were elected. The Honorary Presidents and President of the Congress were Italians. The elected Vice-Presidents were the Heads of the delegations of Germany, United States of America, Great Britain, Dutch East Indies, Japan and Norway. The Presidents of the five sections, into which the Congress was divided for working purposes, were Sweden, Tchecoslovakia, Spain, France and Brazil. India was elected a Vice-President of the section devoted to Tropical Forestry.

The Opening Meeting of the Congress was held on the morning of 29th April, H. M. the King of Italy and Signor Mussolini being present. This was followed in the afternoon by a general meeting and later by a meeting of the Heads of Delegations at which the various programmes of work prepared for the five sections were briefly discussed and agreed to. Of the five days available for this work, two, April 30th and May 1st, were allotted to a visit to the Forest School at Florence (six hours train journey from Rome). and the forest at Vallombrosa. This visit was duly undertaken by a certain number of delegates and proved not without interest. The actual days available for the work of the sections were thus reduced to three, each section having three meetings of 3 hours each. Sections I and III met at the same hours as Sections II, IV-A, and IV-B. It was not, therefore, possible for any one delegate to attend all the meetings, of each section. Since many Governments were well represented this would have been immaterial had the Agenda drafted for each section been confined to well-defined branches of forestry. There was, however, unfortunately, a certain amount of overlapping and this proved somewhat of a hardship, more especially to those countries which had not a strong delegation. India was at a certain disadvantage in this respect. There were available Professor Stebbing, Mr. Howard, Capt. Trotter, Dr. Beeson and Mr. Gorrie, the three first named being the Government delegates. In addition Mr. Pearson and Professor Troup, who were representing Great

Britain, agreed to give such assistance as might prove possible. But India remained weak. Mr. C. R. Robbins attended the opening meetings, but his return to India prevented his services being available as would otherwise have been the case. At the instigation of Presidents or Vice-Presidents of sections some transfer of subjects were made between sections. This proved inevitable but was rather confusing to the rank and-file of the delegates.

Some 247 papers had been accepted by the Congress and a proportion of these were to be read at the meetings. Although précis had been asked for but a small proportion of the authors had taken the trouble to prepare them. Consequently at the opening meetings authors were actually permitted to read their papers *in extenso*. This practice was soon stopped. The allocation of the papers to the various sections was far from happy. Papers dealing with India and other tropical countries were found disseminated through Sections I, II and III, where they were out of place, instead of being grouped under section IV-B, Tropical Forestry. This matter was rectified by the Vice-President representing India before the first Sectional Meeting of IV-B. The section was thus able to start its work with a fair knowledge of what it had in front of it.

As regards the delegation representing India it was arranged that Professor Stebbing and Mr. Howard should attend all meetings of Section IV-B, whilst Capt. Trotter and Mr. Gorrie attended Section II, and Dr. Beeson Section IV-A. Professor Troup attended some of the meetings of IV-B. When Sections I and III were in session Professor Stebbing and Mr. Howard mainly confined themselves to the latter, whilst the rest of the Indian delegates attended Section I.

The subject in Section I which engendered the greatest amount of interest was the question of Forestry Statistics. A Sub-Committee was appointed to deal with this matter, on which both Great Britain and United States of America, were strongly represented, and remained in continued session throughout the five days. The work of this Sub-Committee in itself emphasises the remark made above anent Governments being strongly represented at a

Congress of this kind. The formation of even one Sub-Committee in a single section, to deal with a matter which may be contentious and yet of primary importance to a Government, at once reduces its representation in the Section, since its delegates may have to give their whole time to the work of the Sub-Committee, as was the case in the instance above quoted. A good example of the procedure to be followed at a Congress of this kind was afforded by the French. France had a very strong delegation present, official delegates and otherwise. The writer was acquainted with the bulk of them personally and was also well aware that the French Government had certain questions of forest policy and management in which they were keenly interested. It proved an education in itself to study the able manner in which they went to work in an International Congress in which to say the least, there were the inevitable opposing currents of opinion. It is not too much to say that in each Section, when a matter was under consideration in which France was interested, they succeeded in achieving their object. I except that contentious subject, Forestry Statistics, over which so large an amount of time was expended and in which certain countries evinced a primary interest; to the neglect, in some cases, of branches of forestry of at least an equal importance.

The linguistic difficulties presented at the Congress were very serious. An enormous waste of time was incurred in translating précis of papers and discussion into at least two languages. French was the official language of the Congress, English and German being the other languages used. Practically speaking a delegate loses more than half his value unless he can speak one other of the above-mentioned languages besides his own, unless his own happens to be French.

The work of the Sections may now be glanced at.

Briefly Section I confined itself to questions dealing with Forestry Statistics, policy, economics, legislation, and popular instruction in Forestry. Section II—Trade and Industry in Timber and in Forest Products in general. Section III—Technical problems relating to silviculture and forest management. Section IV-A—Control of Torrents, re-afforestation of

mountain areas, plant diseases, insect pests and wind damage; forestry propaganda, improvement of game and fisheries. Section IV-B—Tropical forestry resources, silviculture, protection, management and research in tropical forests. Uses and export of tropical timbers.

Resolutions on these matters were adopted by each Section and were finally accepted by the Congress at the General Meeting on May 5th (see the enclosure at end of article).

Early in the proceedings it became apparent that papers were being read which ended with Resolutions (which the Sections were invited to endorse) having direct reference to the Governments or the countries represented by the authors—advocating, for example, practices in force in those countries; or, more specific, recommending the direct export of forest produce from those countries to certain others particularly specified. It was felt that such Resolutions, though drafted without *arriere pensé* could not be accepted by a World's Forestry Congress. It was, therefore, determined that all Resolutions adopted by the Sections for submission to the Congress must be drafted in general terms. A perusal of the Resolutions accompanying this Memorandum will show that, in so far as possible, this decision was adhered to.

The papers of which précis were read before Section IV-B in the order taken, were as follows:—"On the possibility of the plantation of forests in Egypt;" "Forests and Forest Research in India;" "Shifting Cultivation in the Forests of Panama;" "Timber of French West African Forests and Italian Industry;" "Forests, Forestry and Lumbering in the Philippines;" "Identification of Timber or Timber Technology in the Dutch East Indies;" "Researches in the Natural Regeneration of Selection Forests in the Dutch East Indies;" and "Forestry Problems in Tripoli." The Governments represented in the Section were India, Egypt, the Dutch East Indies, Philippines, Portugal, Japan Peru, Brazil, Argentine, Chili, French West African Colonies, French Indo-China and Italy.

The first day's meeting was confined to a consideration of the first four papers above mentioned. A resolution was passed

on the French paper and a second on the subject of interchange of Forestry Publications which also recorded that brief résumés of their contents should be given in (if English) French and German—a valuable suggestion which would greatly help to making known the fine work and great progress in forestry matters by the department in India. At the opening of the second session the President (Brazil) drew attention to the recent forest legislation enacted in Brazil and a Resolution was passed on the subject. No one, as a matter of fact, was acquainted with the legislation in question and the President was not *au fait* with the complete forest legislation existing in India. The rest of the session was given to discussing and passing the Resolutions drafted by the writer on the paper "Forests and Forest Research in India," by Mr. R. S. Pearson and himself. Since this paper covered most of the branches relating to Tropical Forestry and the time available for discussion was limited six heads had been adopted and a Resolution drafted upon each. After discussion, the first two Resolutions dealing with Shifting Cultivation and its Utilisation in regenerating the forest were combined into a single Resolution. The other four Resolutions having reference to Working Plans, Grazing, Fire Protection and Research were accepted as drafted. It was interesting to have the South American delegates describing the enormous damage done to the forests of their countries by the unchecked practice of shifting cultivation and firing the forests. The only Resolution passed at the third session was one on the subject of the Identification of Tropical Timbers, submitted by the delegate of the Dutch East Indies.

A considerable number of interesting papers were taken as read, relating to Australia, Guatemala, Forest Service of the Dutch East Indies, Punjab Irrigated Plantations, Re-afforestation in Senegal, Forestry Position on the Ivory Coast, the Export of Teak wood from the Netherlands Indies, British India and Siam, and others.

The Resolutions submitted by the other Sections and accepted by the Congress cover the whole field of Forestry Science and it is perhaps scarcely necessary to add that their detailed study, in conjunction with the papers submitted to the Congress, will

well repay the officers of the Indian Forest Service. The complete collection of Reports will be included in "The Final Acts of the Congress" which it is hoped will be published next November.

An important outcome of the consideration given to Forestry Statistics (see the Resolutions appended) was the formation of a permanent Central Bureau in a Forestry Section of the International Institute of Agriculture at Rome. It was announced towards the close of the meeting that Italy had agreed to provide the funds required to inaugurate the Bureau.

In Section II consideration was confined to wood and charcoal as carburants, standardization of timber measurements and resin tapping. These matters are fully treated in the Report which Capt. Trotter of the Dehra Institute is submitting. Further description of the work of that Section is, therefore, unnecessary.

It is perhaps worth mentioning that the papers submitted by India were few in number compared to many other countries possessing Forest Services of proved capacity. This was probably due to a misapprehension of the actual position. It was not necessary to attend the Congress in person in order to be able to submit a paper. From the Indian Forest Service of the present day papers of high intrinsic value, covering every aspect of Forestry Science, could be submitted to an International Congress. Their absence this year was a distinct loss to the Science of Forestry, to the delegates to the Congress, and to India herself. The writer himself did not know the conditions he was to meet but he spared no pains to become acquainted with them and discussed matters with most of the representative delegates. It may be hoped that India will rectify this omission at the next meeting of the Congress which will take place in 1930. Also that she will have a strong delegation. The gain to the individual is not immaterial. For one meets many great Foresters whose names are household words in forest circles and forms friendships. which are both pleasant and useful in the career of a Forest Officer.

E. P. STEBBING.

TEXT OF THE RESOLUTIONS AND RECOMMENDATIONS PROPOSED FOR APPROVAL BY THE GENERAL ASSEMBLY.

FIRST SECTION.

RESOLUTION PROPOSED BY M. BADOUX.

1. For the purposes of the next World Forestry Congress a review should be made of the present position of forestry legislation and forestry taxation in the different countries, as regards privately owned forests and the results obtained thereby.

2. The States should do their utmost, and at as early a date as possible, to secure by suitable action an increase in the timber yields and the protective value of privately owned forests.

3. The States should take steps to increase the area of public forests, by the purchase by consent of private forests and waste lands suitable for reafforestation.

4. The Congress insists that it is desirable that the work of popular education in forestry should be encouraged in every country.

RESOLUTION PROPOSED BY M. FJELSTAD.

The World Forestry Congress recognising the International Institute of Agriculture is the body which is best qualified for the study of forestry questions involving official relations with the different Governments of the world, recognising at the same time the work which it has already accomplished in the sphere of forestry and the scheme of work which it proposes to carry out, in accordance with the duties entrusted to it by the adhering governments.

Urges that the scheme should be carried out as promptly and as completely as possible in full co-operation with other international forestry organisations.

RESOLUTION PRESENTED BY M. BLOTNICKI.

The World Forestry Congress seeing the necessity and importance of the formation of an International Association of Students of Forestry resolves to support and foster this idea in every country and in all the Higher Schools.

REPORT OF THE COMMITTEE ON FORESTRY STATISTICS.

Terms of Reference.

"This meeting having in view the importance and intricacy of the subject resolve to appoint a small committee representing the timber-producing and consuming nations to consider the most practical forms and methods for collecting, reviewing and disseminating world Forestry Statistics.

"Further they empower the committee when appointed to add to their numbers co-opt members of the committee for special subjects, take evidence and divide themselves for purposes of investigation into sub-committees as they think fit.'

The Committee appointed by the First Commission has the honour to report as follows :—

Need for Statistics.

1. Accurate forestry statistics are required primarily for two purposes:

(*a*) To enable each State to formulate its National Forest Policy. There are as well other secondary purposes which it is not necessary to enumerate in this brief report.

(*b*) To facilitate Trade and Industry.

2. No question relating to raw materials has been more neglected than that of the world's timber resources.* The statistics at present available are extremely unequal in character whether regarded from the point of view of adequacy, intrinsic accuracy or form of presentation. In face of this situation and despite the ingenuity of man in devising substitutes the consumption of timber increases rapidly and taken as a whole the drain on the accessible forests is already sufficient to cause uneasiness. There is need, therefore, for quick action in assessing the true state of the world's position in relation to its prospective timber supplies.

3. International trade in timber already forms an important proportion of the world's total commerce. Consequently as tim-

* *Note*:—The expression "Timber" is used generally throughout this report to mean forest produce.

ber depletion progresses and new countries are opened up international trade in timber must increase and forestry statistics must assume concurrently more and more an international aspect.

Needs for an International Organisation for the Collection of Forestry Statistics.

4. While the data required for the compilation of statistics must in every case be collected by the individual countries themselves there is great need for an international organisation which should be the source of inspiration and would unify methods, collect, co-ordinate and publish forestry statistics.

Location and character of the proposed Bureau.

5. The Committee believe that the International Institute of Agriculture, which already has by treaty official relations with practically all the Governments of the world is in the best position to handle an international project of this kind. They recommend accordingly that a Bureau of Forestry Statistics be set up in that Institute.

6. In view of the highly technical character of the work of the proposed Bureau the Committee recommend that the Director should be a forest economist of outstanding experience and ability who is generally recognised as an authority in this field. He should have the assistance of the necessary staff, which should include technically trained forest economists of recognised ability and experience.

7. The Committee recommend that within the general organisation of the Institute the Bureau be given the maximum permissible degree of autonomy. They believe that a Director such as they envisage will secure the best results if unfettered on the technical side.

8. An essential feature of the work of the Bureau will consist of personal visits of the Director or his assistants to various countries for the purposes of consultation with the responsible authorities. The Committee desire to emphasise the importance of securing personal contact in this way.

Finance.

9. The Committee estimate the annual cost of the Bureau when in full working order at not less than one million lire (approximately $40,000) per annum. This estimate provides for the remuneration of staff travelling and subsistence allowances and publications.

10. The Committee are of opinion that a start might be made with the Bureau when the sum of 500,000 lire (approximately $20,000) per annum was assured They are quite clear however that a Bureau which is inadequately supported will defeat its own ends and they base their case for the creation of a Bureau on the assumption that it is to be first-class.

11. The Committee consider that the necessary funds should be raised by special contributions from the Governments of those countries which are especially interested (namely the great timber consuming and exporting countries), and from the wood-using industries, associations and private individuals.

The Commission strongly urges the official Delegates to the Congress to represent to their respective Governments the importance of the project and the necessity for adequate financial support.

Selection of technical officers.

12. The Committee desire to stress the importance of appointing to the Bureau the best forest economists that can be secured. They recommend that the Institute in making those selections, secure in the first instance nominations for the positions from the countries and organisations contributing to the support of the Bureau and obtain advice, as to the final selection from these nominees from a Committee of technical foresters.

Form of Statistics.

13. The Committee have considered how far it was possible for them to detail the form and method by which forestry statistics should be collected. They have come definitely to the conclusion that in the time at their disposal it is impossible to treat the subject adequately. They recommend therefore that

when the Director of the Bureau has taken up his duties one of the first steps should be to convene a Committee of experts, representative of the countries mainly interested. It would be the duty of this expert Committee to consider exhaustively the question to which, as stated above, the present Committee has been unable to do justice.

14. Meanwhile the Committee ventures to indicate certain general principles to which they attach importance:

(1) The statistics as a whole should be divided into two main branches:

(*a*) The growing of timber.

(*b*) Importation, exportation and consumption of timber.

(2) The basic forms of all statistical returns must be so simple as to secure adequate returns for all important timber countries but at the same time so arranged that they are capable of expansion to meet the possibilites of countries with highly organised forest statistical services. It is, however, indispensable, if the essential aims are to be achieved, that all the important timber countries endeavour to organise their statistics in such a way as to conform to the international plan.

(3) The forest area should be divided:

(*a*) Into exploitable (actually exportable or exploitable within a limited period whether as a whole or whether in respect of certain species only) and non-exploitable. Further subdivision of the exploitable area on the basis of stocking is also advisable,

(*b*) according to ownership,

(*c*) so far as possible according to the system of treatment.

(4) Timber should be divided into: firewood and commercial timber, the latter being divided further into coniferous (hard and soft) and broadleaved (hard and soft).

(5) Statistics on the growth of timber should be so arranged as to show the productivity of the exploitable area and the actual outturn of timber.

Broadly the ultimate questions to which answers are required are : "Is the world living on its capital resources of timber, and if so to what extent?"

(6) In view of the great difficulty which exists at present, in unifying customs nomenclature the Committee suggests that the Institute through its new Bureau of Forestry Statistics, while taking into account former action in this direction should attempt to secure uniformity.

Provision must always be made to meet the existing needs of commerce in the matter of trade statistics.

(7) Information relating to trade should be furnished annually, the remaining data periodically.

SECOND SECTION.

Resolution proposed by M. Jagerschmidt.

That the International Institute of Agriculture should call the attention of the Governments to the importance of encouraging by all possible means such as competitions, exhibitions, control of tests, subventions, premiums to users, the efforts of schemes which have for their object the utilization of wood and charcoal as carburants.

Resolution proposed by M. Frommer.

The Congress expresses the opinion that the International Institute of Agriculture or some executive body set up by the Congress itself should carefully follow the development of the standardization of timber measurements, and that it should collect on this subject from the Governments and qualified Associations all the information that can be brought together with a view to formulating a complete and studied scheme for the standardization of rough and sawn timber as well as of timber still left in the bark. These conclusions should be presented in the form of a draft international convention.

Resolution proposed by Messrs. Oudin, Biquet and Salvat.

That at the request of the International Institute of Agriculture the question of the improvement of the technique of tapping

of the various resinous forest species should receive special consideration in countries in which the development of the industry of resins, etc., can be developed and that the experimental stations should communicate with each other the results of the studies made.

THIRD SECTION.

RESOLUTION PRESENTED BY THE DRAFTING SUB-COMMISSION FOREST MANAGEMENT.

The World Forestry Congress.

1. Considering that methods of treatment at present applied to forests cannot afford any guarantee against shortage in production and economic crisis, recognises that it is necessary to improve method of management so that they may be considered in all States not merely as a form of regulating the forest working but as a means of organising intensive cultivation.

For this reason the Congress calls attention to the necessity for pursuing continuously the study of forestry economics on the basis of the natural sciences.

2. The Congress is of opinion that management should give first place to methods of cultivation and that it should be increasingly regarded and organized (according to technical and economical requirements) as a means of observation and counsel for methods of treatment in which the most important consideration after the preservation and regeneration of the forest, should be the development of production.

3. The Congress requests the International Institute of Agriculture to publish a series of practical and clear examples of the various forms of management adopted for different types of forests, including also instructions on the subject provided by different forestry administrations throughout the world.

RESOLUTION PROPOSED BY M. D'ALMEIDA.

Considering that the production of cork increases every year and that the consumption does not appear likely to be augmented in the future,

Considering also the importance of the cork oak for the afforestation of Mediterranean countries,

The World Forestry Congress resolves as follows:—Scientific Institutions should take up the study of new uses of cork in order to increase its value and to encourage the industries which make use of it.

GENERAL RESOLUTIONS PRESENTED BY THE THIRD SECTION.

(1) That the attention of forestry workers in all countries should be directed to the importance of varieties in forest species and that experiments in forestry genetics should receive consideration in all forestry research stations.

(2) That forestry administration and experiment stations should consider the means of placing at the disposal of forestry workers and individuals under satisfactory conditions selected seeds of authentic origin and that by means of an international collaboration and the establishment of a system of exchanges the results obtained in one country may be made to serve for all others.

With regard to the question of the valorization of bare lands the Third Section is of opinion that it can be fairly stated that in temperate countries there is no land so arid that it cannot be afforested whatever be the climate (in respect of dryness and temperature) but the solution of the problem present special difficulties, requiring the use of minor aids, including the protection and development of humus protection against drying winds, against the natural drying up of the soil, etc., etc.

The Congress recommends forest workers in all countries with a dry climate to use every effort to bring about the afforestation of bare lands as a means of controlling the extension of useless areas and depopulation.

RESOLUTIONS PROPOSED BY SECTION 4-A.

I.—CONTROL OF TORRENT WATERS.

The World Forestry Congress expresses the opinion that:—

(1) Where special circumstances involve a division of the work between the Civil Engineering and the Forestry Services,

it will be advisable to take measures for as close a collaboration as possible between these services. In this case, once the area has been defined the zones of influence will be traced and it will be determined by common agreement which are the chief works to be undertaken and which those of secondary importance. It will then be only necessary to lay down a single programme for carrying out these schemes.

(2) It will be essential in the first instance to carry out all such works as are of immediate necessity for the avoidance of serious destruction. Forestry work will be carried out at once in the upper catchment areas for there alone it has lasting effect and is able to change strong and dangerous torrents into clear and beneficial water courses.

II.—CONTROL OF INSECTS.

The World Forestry Congress expresses the opinion :

(1) that an effort should be made to ensure that all the Forestry Experiment Stations of the world proceed to make a detailed examination of the influences of climate on the mass propagation of noxious insects ;

(2) the Commission of Experts for Plant Protection of the International Institute of Agriculture as well as the competent service of the Institute should give special attention to the study of climatic influence on the propagation of insects which are forest pests ;

(3) that the control of the pest known as the 'nun moth' (*Liparis monacha L.*) should be undertaken on the basis of a well organised system, embracing the results of the most modern theory and practice, and in particular attention is drawn to the system proposed by the Reporter, M. Rasek, Delegate of the Institute of Phytopathological Researches at Brno, Czecho-Slovakia.

(4) that the competent service of the International Institute ; of Agriculture at Rome should put itself into touch with the national experiment institutions of forest phytopathology and entomology in order that it may receive the following information regularly and with the least possible delay :—

(*a*) the appearance and spread of diseases and pests attacking forest species ;

(*b*) the new methods of control appropriate in each case, both from the technical and legislative standpoint ;

(*c*) all other information in this connection.

This service of the International Institute of Agriculture shall, as promptly as possible, convey this information to the institutions concerned.

III.—CONTROL OF CRYPTOGAMS.

The World Forestry Congress expresses the opinion :

that the results obtained in the different countries as regards the control of the ink disease of the chestnut tree in particular in connection with the exotic plantations of *Castanea*, should be centralised in such a manner as to make it possible to establish an effective method of control.

IV.—CONTROL OF WIND.

The World Forestry Congress, at its Rome meeting, having considered the statement made by the Delegate of the Government of Uruguay, expresses the hope that an enquiry may be made by the International Institute of Agriculture into the different methods in use as regards damage from wind and into systems of protection, especially into the effect of wind-screens formed of belts of trees which serve to protect cattle as well as cereal crops and fruit trees, etc.

V.—CONTROL OF FIRES.

The World Forestry Congress :

In view of the destruction caused by forest fires and the universal importance of preventing their recurrence ;

resolves that in countries where owing to the dry climate the forests are subject to risks of conflagration, the Governments should be invited :

(1) to preparea list of fire zones, in their respective territories ;

(2) to make generally known the measures adopted in such regions for preventing or checking forest fires ;

(3) to communicate this information to the *Office Forestier International*, so that it may be possible to institute a system of experiment and to build up a body of authoritative knowledge.

VI.—Pasture Land.

(*a*) *Improvement of communal pasture land.*

Communal pasture land.

The World Forestry Congress,

considering that in many countries there are large extents of almost entirely unproductive communal land in the state of "landes" or useless pasture lands,

that the normal utilization of these lands is on one side pasture and on the other forest and that crop production is thus closely allied to reafforestation and that the poor condition of these properties is due to the fact that up to the present time they have not benefited by a regular administration which attempts with continuity and method the realisation of this twofold sylvo-pastoral aim ;

express the hope :

(1) that foresters be given the administration of these properties together with that of the forests ;

(2) that existing forestry research stations introduce into their curriculum the problem of the improvement of the different types of pasture land and of "landes" in view of crop production.

(3) that in cases where the deterioration of pasture lands is such as to entail immediate danger, either from erosion of mountain land, flooding or avalanches, the State shall intervene either by way of expropriation or by any other method, with the object of trying all means to avert these dangers.

(*b*) *Migration of sheep.*

The World Forestry Congress makes the following recommendations :

(1) It is desirable that the Governments of European States possessing colonies or having protectorates in Africa as well as the Governments of independent African States should pay special attention to the changes in the rainfall and springs as also the changes in climate which are the result of the deforestation which is spreading on the continent; these changes constitute a danger to the future of colonization, agriculture and river navigation;

(2) It is desirable that the Governments should lay down effective regulations with regard to pasturing and specially with regard to migration of sheep; such migration has been reported to be one of the chief causes of deforestation and sterilization both in itself and by reason of practical consequences; such regulation is considered to be an *ad interim* measure of the highest importance;

(3) It is necessary that steps should be taken as soon as possible by means of effective legislation to protect the fertility of all land suitable for cultivation and settlement by natives and immigrants.

VII.—Protection of Natural Features.

The World Forestry Congress expresses the hope:

(1) that all the countries which have taken note of the resolutions presented up to the present in the various international Congresses for universal co-operation for the Protection of Natural Features and the conclusions of the Paris Congress of 2nd June 1923, will take the necessary measures to safeguard the threatened species, by devoting particular attention to local species, by establishing national and international reserve parks, arboreta and Alpine gardens;

(2) that steps should be taken in all countries, and in particular in the vicinity of large towns, with a view to the preservation of public parks and artistic wooded cantons, employing as far as possible the usual forestry methods, but always in such a way as to reconcile the interests of the public and of artists while avoiding any check to the regeneration of the forest;

(3) that the Governments of all countries should include in the syllabus of schools of every description as a compulsory subject instruction with respect to the protection of natural features;

(4) that there should be instituted measures of propaganda for nature protection by means of lectures, the press and pictures, and

(5) that they should give moral and material support to societies, corporations and private individuals engaged in such protection.

VIII.—Game and Fishing.

The World Forestry Congress,

in view of the fact that the International Institute of Agriculture deals with questions arising out of game and fishing both in the sphere of legislation by assembling regularly the legislative provisions on the subject, and in the technical sphere in the form of articles published in the *International Review of the Science and Practice of Agriculture;*

in view of the fact that questions connected with game and shing are of great importance for forestry;

expresses the hope that the International Institute of Agriculture shall continue and if possible intensify its enquiries as regards these questions equally from the legislative and the technical standpoint.

SECTION IV-B.

Resolution proposed by M. Bertin.

The World Forestry Congress,

having considered the valuable report presented by Mr. Bertin on the question of the diffusion of French Colonial timber in the interests of Italian industry, expresses the hope that the interested Governments will encourage by all means in their power the importation of tropical timber into the countries which make use of this class of timber.

RESOLUTION PROPOSED BY MM. PAULET AND FISHER.

The World Forestry Congress

having considered the valuable decree of the Brazilian Government, dated 16th September 1925, reported by Dr. Deoclesio de Campos containing regulations for the Forestry service,

recommends the International Institute of Agriculture to call the attention of all Governments which possess tropical forests to these regulations which constitute one of the most complete, successful and modern schemes of legislation on the question.

It also recommends that the Forestry legislations in all tropical countries possessing a Forestry service for giving practical effect to the laws should be brought to the attention of all Governments which possess tropical forests.

RESOLUTION PROPOSED BY KRAMER.

The World Forestry Congress

recommends that the delegates of tropical countries should give the President of the Commission 4-B the names of the important forestry journals of which they have knowledge.

It also recommends that the delegates of tropical countries should request the editors of the Forestry journals in their country to give after each important regulation a brief resumé in French, English and German.

RESOLUTIONS PROPOSED BY PROF. STEBBING.

The World Forestry Congress resolves :

(1) That this Congress, being convinced of the extensive damage done to forests in tropical and sub-tropical countries by the practice of uncontrolled shifting cultivation urges on all Governments concerned the necessity for regulating this practice: it invites attention to the excellent results obtained in certain countries by utilizing the practice of shifting cultivation for the establishment of forest plantations, and advises the extension of this system of regeneration wherever possible : only

where such measures fail the Congress urges that resolute steps be taken to restrict the practice of shifting cultivation to the utmost extent possible.

(2) That this Congress is of opinion that, in view of the large and increasing demand for timber and other produce required for the industries of the World, that all forests which are under exploitation should be placed under some form of Working Plan based at least on a knowledge that overcutting the possibility is not taking place.

(3) This Congress is of opinion that the practice of unrestricted or ill-regulated grazing in forests of a tropical or semi-tropical nature, both in the plains and the hills, is destructively harmful to the forest growth and to regeneration and if practised unchecked results in the gradual degradation and ultimate certain disappearance of the forest.

The Congress is of opinion that Working Plans drawn up for areas of forests subject to grazing should have carefully drafted grazing regulations attached to them.

(4) The Congress would strongly call the attention of Governments responsible for tropical and semi-tropical forests to the enormous damage committed by uncontrolled fires. That the practice of burning the forests usually in the interest of grazing is directly harmful to the forests and entails sure degradation and extinction of forest tracts subjected to such practice.

(5) The Congress draws attention to the important part which research takes in the management of areas of forest and would invite Governments responsible for tropical and sub-tropical forests to study the lines of advance taken by British India in connection with the experiments carried out at the Dehra Dun Institute and to compare them with the work done in other countries.

RESOLUTION PROPOSED BY THE DELEGATION OF THE DUTCH INDIES.

Considering that it is of special importance to the users of timber that tropical woods used for trade purposes should be

known under their scientific names in order that there should be no confusion with timbers of inferior quality ;

Considering also that the methods described in the report of Dr. den Berger shows how this end can be achieved in a simple manner.

The delegation of the Dutch *Indies resolves that :*

the World Forestry Congress having considered the report of Dr. von Berger on practical means of identifying timbers calls the special attention of the International Institute of Agriculture to the investigations made by the Experiment Station of Buitenzorg (Java) to the end that this method may become better known in other tropical countries and applied therein.

AN ATTEMPT TO ANALYSE THE EFFECTS OF GRAZING ON FOREST CONSERVATION IN THE CENTRAL PROVINCES.

That grazing is harmful to forests is so old a tradition that many foresters are prone to accept it as a fact without further enquiry. With one or two exceptions this has certainly been the case in the Central Provinces. The older plans, mostly prescribing selection, improvement or some form of coppice fellings, also prescribed closure to grazing for periods usually of five or ten years *after* felling. That this was not quite all that was desirable has doubtless occurred to many Working Plan Officers in these Provinces but most of the attempts to introduce any other system have been still-born or have succumbed to agitation. One notable and successful attempt is in the case of Nagpur-Wardha Plan according to which coupes of a coppice-with-standards working circle on 45 years rotation are closed to grazing during the first five years after main fellings and again from the 16th to 20th years and 31st to 35th thus giving alternations of five years closure and ten years open to grazing. The difficulty with many other plans has been the shortness of the rotation (or cycle), rarely more than thirty years and often less; so that a closure of ten years meant $33\frac{1}{3}$ per cent. of the area of each *felling series always closed to grazing.*

From a somewhat casual study of grazing it seems that it may cause deterioration to a forest in several ways,—

(*a*) *Soil*

(*i*) Trampling.

(*ii*) The removal of mineral products.

(*b*) *Growing stock*—

(*i*) Browsing.

(*ii*) Breakage.

(*iii*) Trampling of young regeneration.

The effect of trampling of the soil varies somewhat with the physical condition of the soil. In loose sandy soils the effect appears to be to make the soil looser and to result in denudation. Examples of this can be seen in almost any Division of the Central Provinces particularly on the outskirts of the forest. It is a very noticeable fact that the forests improve as one marches away from large cultivated tracts of country. Isolated small reserves and peninsulas of forest surrounded by well cultivated lands are invariably poor in quality. Admittedly to some extent this is due to heavy fellings but without grazing teak and the mixed forest species have an extraordinary recuperative power which can prevent permanent deterioration. The effects of heavy and repeated fellings without grazing can be frequently seen on ungrazeable hill slopes in private forests near habitations. Such areas are sometimes full of young regeneration and misshapen stems but with no tree of any commercial value. When the area near a village is grazeable it is invariably heavily grazed. As soon as the green grass appears it is eaten or trampled into the ground so that heavily grazed areas never get a chance to seed. The continuous trampling of the light soils breaks up the surface and the next shower of rain carries away the broken soil ; the result of this is ravine formation and the rapid disappearance of all soil and consequent deterioration of the existing stock and impossibility of regeneration being able to establish itself. Such effects are slow and cannot perhaps be seen from year to year but the comparison of the ground with the 4" maps made thirty to forty years ago will sometimes show ravine formation very clearly.

On stiffer soils the effects of trampling are by no means so serious for they are less permanent and slower in action. The result is usually the hardening of the clayey soil and the principal effect besides bad soil aeration is that the heavily grazed areas contain no regeneration because the delicate radicle of the seed cannot penetrate the hardened soil. In certain cases swamps may be formed in localities slightly below the general level but the effects of trampling on such soils can, it is believed, be more or less remedied by closure to grazing.

Cattle grazing in a forest remove certain mineral products in the food they consume some of which, but not all, is returned in the form of manure ; this must result in steady deterioration. The Forest Department in India can probably produce no experimental results in proof of this fact but the collateral support of agricultural experiment and European forest experience is sufficient alone to justify the assumption for the Indian Forests.

The effects of browsing and breakage are not very serious except in young woods. Goats are excluded from most of the valuable Central Provinces forests. Buffaloes do a certain amount of damage in some localities but though serious, it is not of paramount importance. Breakage and bark rubbing are similarly only serious in young woods.

A large quantity of germinating seeds are trampled into the soil by the hoofs of grazing animals and much young regeneration is destroyed.

From the above remarks it seems that the effects of the trampling of cattle on soil and regeneration are quite as important as the effects of browsing and breakage in young woods. Generally one can say that where regeneration is absent, its absence can usually be ascribed to grazing. This is, however, not universally true (*e.g.* the sal forests of the Banjar valley, permanently closed to grazing but with little regeneration.)

The adverse effects of grazing may be said to be :—

(*i*) Denudation of light soils ; hardening of heavy soils, bad soil aeration.

(*ii*) Deterioration of soil quality; extent not measurable at present.

(*iii*) Prevention of establishment of regeneration.

(*iv*) Damage to young crops and individuals.

Item (*iii*) is largely the result of (*i*) and is particularly noticeable along grazing tracks, the tracks used daily by cattle from the village to the grazing grounds. One can frequently trace the regular grazing tracks of herds through the forest by the complete absence of regeneration, whereas adjoining forests of similar type and on similar soil which by some accident of topography lie off the grazing track are densely stocked with regeneration.

THE APPLICATION OF GRAZING CLOSURES.

Should the above surmises be generally accepted as facts the question arises how best to utilize these facts for the benefit of the forests. To a very large extent it depends on the method of management. Ideas on management in the Central Provinces are in a somewhat fluid state at present but as all the principal species appear to be light demanders the trend seems to be in the direction of some form of the so-called uniform system with concentrated regeneration (which includes coppice and coppice with standards). Most of our species can and do regenerate very well except in poor localities and in one or two exceptional cases in better localities. If we are to manage the forests on the uniform system it is desirable to make the regeneration period as short as possible. The ideal is of course a mature forest with full regeneration so that a compartment can be completely regenerated in one operation of complete removal of the overwood. The writer's opinion is that if the last thinning partakes of the nature of a preparatory felling (French) and if grazing can be excluded for ten to twenty years *before* the main regeneration operation we shall be able to approach fairly closely to this ideal. Regenerated forests must of course be closed to grazing for some years to allow them to grow up out of danger. Either ten or five years are the usual periods. Five years is ample in our best quality forests but there is some doubt whether it is sufficient for the poorer areas.

The innovation then (for the Central Provinces) proposed now is the closure to grazing *before* main fellings with the object of establishing regeneration before fellings. It is maintained that closure to grazing after main fellings is practically useless for this purpose for in the second year after fellings the coupes become choked up with grass which completely prevents the establishment of new regeneration. There are serious practical difficulties against increasing the percentage of area closed at any time to grazing but fortunately it is nearly certain that most coppice rotations will be lengthened and that forests up till now managed under improvement fellings on cycles of about thirty years will henceforth be worked under regular methods on rotations double or treble as long; by reason of this fact it will be possible to apply long periods of closure to grazing without increasing the percentage of area closed permanently to grazing. It is suggested that for each Working Circle, Felling Series or Grazing Unit as the case may be, the maximum area to be closed permanently (*i.e.*, average area closed annually) shall be worked out by a comparison of silvicultural requirements and grazing demand. A simple sum in proportion will give the number of years of closure for each coupe.

$$\frac{\text{Area closed to grazing}}{\text{Area of felling series}} = \frac{\text{Number of years of closure}}{\text{Rotation}}$$

Of the resultant number of years of closure, not more than five will be needed for better quality forests after working to allow the new crop to grow up and five or perhaps a little more for poorer quality. The rest of the period of closure can be used before working to enable regeneration to establish itself. Unfortunately this means that the poorer forests which are invariably subject to a heavier grazing demand and which consequently are naturally worse regenerated and are always worked on a shorter rotation, will also have a shorter period of closure to grazing. On the other hand it can be remarked that such forests contain a very much larger number of stems per acre than better quality mature forests so that only a small amount of natural regeneration is required to supplement coppice in order to give a full crop.

THE INVESTIGATION OF CENTRAL PROVINCES WORKING PLANS BY A REVENUE OFFICER.

A few words on this subject are added as it may be of interest to forest officers of other provinces. Some fifteen or twenty years ago the Local Government realised that considerable difficulty was arising in sanctioning working plans owing mainly to the opposition by revenue officers to the closures to grazing involved, on the grounds of serious inconvenience to the cultivators. The Local Government ordered that after each working plan was drafted it should be examined in detail by a Revenue Officer on tour with the Working Plans Officer, particularly as to its effect on the population. The Revenue Officer submits a report which is printed together with Government's orders as an appendix to the plan. This innovation was received with considerable opposition by some forest officers but it has proved, however, a very great boon to the Department. Formerly the I.C.S. as a whole had little real knowledge of forestry and no sympathy with the ideals of the forester. Nowadays when quite a number of Deputy Commissioners have during their service made such a Working Plan enquiry the Revenue Department has become a great friend and sympathiser with the Forest Department because of more intimate knowledge of its aims and ideals; in fact, the Forest Department has had a splendid opportunity of educating the Revenue Department in silviculture and other forest matters. It is a very remarkable fact how knowledgeable many of our Deputy Commissioners now are on the more technical side of forest matters.

The *modus operandi* is more or less as follows: As the Working Plan is nearing completion the Local Governments appoint an officer of about the standing of a Settlement Officer to investigate the plan, and its effects on the local population, grazing being the main, but by no means the only head. The Working Plan Officer supplies him with a copy of the draft plan, maps and detailed figures of the past such as statistics of grazing demand. The Working Plan Officer, naturally an enthusiast, explains his plan in detail and later on has many

opportunities on tour of showing the Revenue Officer examples of the effects of heavy grazing, irregular fellings, and other matters on which he desires to obtain greater control. Provided the Working Plan Officer is sure of his facts he can always be sure of securing the sympathy of the Revenue Officer and that is half the battle. The two officers tour together in representative tracts for a period varying from one to four or even six months. The system of grazing closures is examined in the greatest detail, sequences of coupes are rearranged to give the greatest facilities to the surrounding population consistent with the closures to grazing dictated by silviculture. The people are freely encouraged to bring forward their grievances and at the same time the Forest Department have an opportunity to make known their difficulties with regard to labour; in fact the whole subject of the relations between the department and the people are examined and usually placed on a far more satisfactory basis. Other matters examined are the rates for forest produce including grazing, the question of the restriction of commutation for *nistar* (if it exists), the facilities to the public for obtaining forest produce and numerous other points of remarkably diverse nature. The Working Plan Officer usually has many opportunities of seeing the report as it is drafted and controversial matters can be thrashed out so that by the time the work is completed the two officers are usually in complete agreement. The report is then submitted through the Deputy Commissioner, Conservator, Commissioner, Chief Conservator of Forests to the Local Government. Orders are then passed and are embodied in the report and plan. The Divisional Forest Officer usually finds that these reports are very helpful to him and greatly strengthen his hand whenever questions arise of the relations between the Forest Department and the local population.

C. M. HARLOW,

I.F.S.

BURMA FOREST SCHOOL

PRIZE DISTRIBUTION AT PYINMANA.

The annual prize distribution of the Burma Forest School took place on Wednesday, May 5th. The Hon'ble Minister for Forests Mr. Ah Yain attended the proceedings.

Mr. A. H. Lloyd, Director of the School, in his address welcomed the Hon'ble Minister on his first visit to Pyinmana. It was the 13th prize-day held at Pyinmana and the 25th since the school was first started at Tharrawaddy.

Thirty students completed their two years' course. Seven casualties for various reasons occurred in the English class of 17 students which began in May 1924. Of the remaining ten students one was awarded Honours and all got the Higher Standard certificates. There were five casualties in the Vernacular class of 25 students. New methods of selection and preliminary training will, it is hoped, reduce the high percentage of casualties.

Mr. Lloyd also referred to the difficulty in getting students with the requisite knowledge of English and general education. Forest life was very different in many ways from what it was popularly supposed to be. The work and conditions of life of a Ranger should now be quite congenial to many who hesitated to take these appointments.

The Vernacular Class consisted of 20 students who all had previous subordinate forest service. One obtained Honours and the rest Lower certificates. Reference was made to the revised syllabus introduced to make the training more practical and to the special course of lectures in First Aid and Hygiene. The health of the students had been better than usual. Reference was made to the Athletic Sports and the success of the football eleven which won 12 matches out of 17 played and also won the Pyinmana football tournament.

Under the instruction of Mr. Edge boxing had been taken up seriously for the first time. The keenness of the students was due to the untiring efforts of Mr. Edge. All students attended drill and Swedish exercises every morning. A Gymnasium and swimming bath had been sanctioned.

The loss of Mr. Scott who had been Director for the first half of the year was referred to. The directorship had also been held for several months by Mr. Burnside who was then leaving Pyinmana after five years of very unselfish and useful work. Mr. Lloyd paid him tribute for his unfailing readiness to help and his popularity with students and staff. Reference was made to the interesting trophies received for the museum. A fine bison head was received from the Pidaung reserve ; the railway receipt bearing the legend " One wild cow's dry head."

The D. F. O's of the various divisions in which the School toured were thanked for their assistance and Messrs. Moodie, Marlow and U Kyaw for their interesting lectures and demonstrations.

The Director's speech was then translated into Burmese and the certificates awarded were distributed by the Chief Conservator of Forests.

Mr. H. W. A. Watson, Chief Conservator of Forests, then made the following speech :—

Mr. Ah Yain, Mr. Lloyd, ladies and gentlemen,—I must first of all on behalf of the Department thank the Hon. Forest Minister for having found time to attend this function and I must next thank the Director of Public Instruction for honouring us with his presence, and finally thank the Director for his very interesting review of the year's work of the School.

Life in the Forest Department is different from life in other Departments. In a way the Forest officer has more hardships as men brought up in towns measure hardships ; but to a man who takes an interest in the forest, and only such men should join the Forest Department, the life is full of interest and far preferable to the possibly more comfortable conditions in other walks of life. The main thing is to take an interest in the forest and in the work being carried out for its development and to think out the reason of everything that is being done. A man who tries to carry out orders without understanding them is a bad kind of slave and never likely to rise in life. Good and intelligent work is necessary for progress and especially necessary in the Forest Department. The record of the Subordinate Forest Service is on the whole a

record of good and honourable work and the object of the Burma Forest School is to improve the knowledge and develop the intelligence for carrying on the work by imparting an elementary teaching in forestry and matters connected with forestry. The teaching is as far as possible practical and you students have to carry out all types of forest work yourselves. This practical work is very necessary and the more you get of it the better. No man can expect to manage labour properly unless he himself is competent to take a hand in the work. A man who can do a job of work such as felling a tree or blazing a tree as well as the casual labourer he employs gets the best work done, whereas the intelligent labourer takes little interest in and works badly for any unpractical man that tries to supervise him. There is nothing undignified in manual work. It is good both for the body and for the mind. I mention this as I have heard murmurs about the arduous practical work at the School and can only say that the more arduous and more practical it is the better for all concerned in every way. You can never learn how to do a job of work by reading how it should be done or how to manage labour by reading books.

The traditions of the School are good at work and in the play ground. Students leave it with a good elementary knowledge of what is required of them and their future depends on themselves. The knowledge acquired at the School is merely a foundation on which to build, the superstructure must consist of good honest and intelligent work. Such work will take a man far. He may not get into a higher branch of the Service owing to his particular limitation but a really good Ranger is in his own way as valuable as a gazetted officer. He is responsible for all executive work in his range and is the main direct agent of Government for the improvement of the forests and the contentment of the people depending on them. In fact good Rangers are the backbone of the Department.

I have mentioned that the School has established good traditions and it is up to future students to maintain these traditions. There were, however, several lapses during the past year which resulted in three students being removed for offences against

discipline. I trust lapses of this nature will not occur again. The maintenance of discipline is most important both in the interests of the School and in the interests of the Department and offences against discipline reflect both on the School and on the Service to which you belong.

When I mentioned that the record of the Subordinate Forest Service was on the whole good, I had to qualify that mention and the main reason for the qualification is the constant charges of corruption that are levelled at Forest subordinates. Usually the charges are vague and general; but my long experience as D.F.O. has told me that in far too many cases officers of the Subordinate Forest Service are not free from the taint of corruption. I look to you students to improve matters and to do your best to prevent the traditions of the School and also of the Service to which you belong being tarnished by a reputation for corruption.

I must now touch a subject that I have much at heart, namely protection of the harmless animals and birds that live in the forests. It seems strange that I who have no traditions against taking life should have to preach on the subject to members of a nation the precepts of whose religion are against taking life. Yet the position is that the younger generation in Burma is apt to spare nothing, neither the helpless young nor the mother on whom they depend. Such be ıg the case, with the increase in the number of licensed guns the position of wild life in the forest is very hopeless. We have rules to regulate hunting. These rules are designed to help the harmless animals whilst allowing reasonable hunting. Yet they are frequently disregarded and in many cases the blame for this disregard rests on members of the Forest Department one of the duties of which is to see that they are enforced. I trust that you will study these rules and by your example and help see that the harmless birds and animals in the forest are given a reasonable chance. It will be a disgrace to the present generation and a loss to future generations if no proper interest is taken in the subject now. The forest without its usual accompaniment of birds and animals would be a very uninteresting place.

You will have noticed that the English Class contains fewer pupils than formerly. This is due to the fact that the output from this class was so numerous that it was blocking the promotion of men from the vernacular class. I hope to put proposals before Government to remedy matters and to allot a definite percentage of posts in the Ranger grade to men with vernacular qualifications.

In conclusion I must wish you all the best of luck and in especial every success to the outgoing students in their career.

A translation of the speech into Burmese by U Po Thit, Vernacular Instructor, was then read.

The medals and prizes were then presented by the Hon. Minister for Forests.

GOVERNMENT SILVER MEDALS.

ENGLISH CLASS.

The best second year student in Forestry.—Probationary Deputy Ranger Saw Abbott, Silviculturist Division. The best second year student in Forest Engineering and Surveying.—Probationary Deputy Ranger Saw Abbott.

VERNACULAR CLASS.

The best second year student in Forestry.—Head Forester Maung Chan Mya, Lower Chindwin Division. The best second year student in Forest Engineering and Surveying.—Head Forester Saw Maung Zan, South Tenasserim Division.

Gold Medals, Silver Medals and Prizes by Donors.

The U Po Hnit Gold Medal for the best student in the English Class.—Probationary Deputy Ranger Saw Abbott, Silviculturist Division. The Old Students Gold Medal for the student in the Vernacular Class most likely to make a good Forest Officer.—Head Forester Maung Chan Mya, Lower Chindwin Division. The J. E. Du Bern Gold Medal for the best Athletic —Probationary Deputy Ranger Saw Aung Nyunt, Prome Division. The Indian Forester Prize for the best practical Forester in both Classes.—Head Forester Saw Maung Zan, South Tenasserim

Division. Special Gold Medal presented by Mr. J. L. Baker, Conservator of Forests, for the winner of the Marathon Race.—Head Forester Maung Sein, South Pegu Division.

The Hon'ble Minister in his address congratulated Messrs. Scott, Burnside and Lloyd on their work as Director but deprecated the frequent changes in the post. He also congratulated the students on maintaining the traditions of the School but regretted the numerous casualties especially those due to the lack of discipline.

He referred to the recommendations of the Forest Committee which proposed certain amalgamations in subordinates' posts and the introduction of time-scales for Foresters, Deputy Rangers and Rangers. It was impossible to say if the scales would be sanctioned but a substantial improvement in prospects might be expected especially in the lower grades.

The Forest Committee concurred in the maintenance of the existing position with regard to the departmental extraction of teak in Myitmaka. In other areas departmental extraction would be limited to the requirements for special purposes. Departmental extraction of hardwoods on a commercial scale would not be undertaken. The present system of long leases to large firms with big capital was considered satisfactory and would not be interfered with. More accessible forests would be worked on short term contracts. For the most accessible areas a system of royalty plus a lump sum premium was recommended pending the possibility of introducing a lump sum purchase contract.

The very important question of fuel supply in densely populated areas was referred to. The Local Government adhered to its policy not to reserve areas in densely populated tracts unless the villages asked for reservation,—which reservation should be free of rights—and were prepared to pay reasonable rates for fuel and other forest produce. Reservation in the more settled districts had begun to reach its natural limits. A great deal of the unclassed forest was not really forest at all. The ideal was to reserve where it was worth while and to abandon the rest. All proposals for reservation were very carefully examined before any action was taken. After reservation came survey and the

preparation of a working plan. Local demands have to be met from the most accessible areas and trade demands from areas of lesser accessibility.

The importance of silvicultural and technical research was referred to. Lack of staff had caused neglect in the past. There was no ground for despondency about the forest revenue. There had been an abnormally high revenue in 1921-22 but there had been a steady and unchecked rise in Forest Revenue in the last 11 years from just over Rs. 80 to 200 lakhs. For further expansion of revenue Burma must look to the royalty from the increasing extraction of other hardwoods, fuel, bamboos, and other produce.

"To all those students who have passed out this year I desire them to remember that this School is a place where the traditions of public service are strong. For a quarter of a century, men who went out from this School have been sacrificing themselves to meet the needs of the country accomplishing work whose full value is appreciated by everyone. The country expects us to do for the future the kind of things that have been done for the past, and to make this School stand for ever for loyalty, for courage, for the subordination of individual ease and individual gain to public ends of lasting importance. These are the traditions of service which you are called upon to maintain. Every failure to assume public responsibility will be noted by your fellow men to your discredit; just as surely as any flinching on the part of the soldier redounds to the discredit of his uniform. Every instance of good work, great or small, even though it receives no material reward in the way of decoration or promotion, enhances the glory and strengthens the inspiration of this School, just as any deed of soldierly valour on the field of battle strengthens the hold of the army upon its members and upon the country.

"All the traditions of this School call you to the service of your country. May it be your lot to follow in the footsteps of your predecessors and face the problems of to-day in the same spirit of self-consecration; bound to your duty not by laws alone or by creed alone, but by the honour of the service."

This concluded the proceedings and the Hon. Minister and the visitors then inspected the display of students' work which

included collection of botanical specimens and economic products.

Refreshments were served to the guests and the usual group photograph taken.

A pagal gymkhana was held in the afternoon in the School grounds. The students dispensed hospitality. Mrs. Burnside presented the prizes. The Chief Conservator of Forests concluded the proceedings with a short speech thanking Mrs. Burnside for all she had done for the entertainment of the guests and called for three cheers which were given with enthusiasm.

In the evening an *Anyein Pwe* was held in the School grounds and attracted a large audience.

REVIEWS.

MEASUREMENTS OF THE CUBICAL CONTENTS OF FOREST CROPS.

OXFORD FORESTRY MEMOIRS, 4, 1926, BY M. D. CHATURVEDI, B.Sc.

This Memoir of 142 pages is, as is set forth in the sub-title, a critical investigation into the methods of measuring sample plots with special reference to the liability to error, and is the outcome of a laborious field study of a sample plot at Hagsfeld,

Baden. The author, who successfully presented the paper as a thesis for the B.Sc. degree at Oxford, was fortunate in having the help and advice of such eminent continental foresters as Drs. Schwappach, Karl Philippe and Beck, as well as that of Prof. Troup and Major Caccia, but he has evidently studied his subject thoroughly, perusal of the mass of literature (111 authors, 153 citations) quoted in the bibliography being alone no mean undertaking. The arrangement is open to a little criticism but only in detail, and the printing is as faultless as one expects of the Oxford University Press, the only misprint noticed being "ρ" for "p" on p. xv. The memoir is in two parts, the first entitled "General Notes" dealing with the measurement of the single tree whether any tree at random or a selected sample tree, and the second with the measurement of the cubical contents of woods; there is also a short introduction discussing the meaning of accuracy, or rather of error, and a conclusion concerning specific recommendations to be discussed below.

There is a detailed discussion of that interesting question, the relative merits of calliper and tape measurements for obtaining basal area, which is perhaps a little misleading in that it is so presented as to make the errors involved in rounding off to whole units appear particularly those of callipers instead of being generally applicable. Omitting this and the matter of the number of decimal places required, we still find listed five kinds of errors involved in the use of callipers as compared with only two for tapes, one of them (the non-circular cross section), only amounting to one per cent. and the other (measurement on a slant) being only half the corresponding error with callipers. The author concludes "The probability of errors in calliper measurements cancelling out one another has been advanced as an argument for the superiority of the callipers over the tape. But as a matter of fact it is easier to standardise the errors of the tape which are always in the positive direction, than the errors of the callipers which are unsystematic" (p. 23). From the mathematical point of view, the decision appears all in favour of the tape, though for completeness' sake, the matter of the flaking off and chance inequalities of the

bark should have been examined. It is then quite disappointing to find so rigid a mathematician apparently putting through his research with calliper measurements, and not analysing the reasons why the continental Research Institutes have shifted over to diameters, a change in which our Indian Forest Research has followed them. Of course, it is obvious that the use of callipers for research and for ordinary forest work in less qualified hands, are two separate questions, though this is freqnently forgotten. In the section concerning height measurements, it is emphasised how far the error introduced by the non-verticality of the tree, exceeds other errors, a point very commonly lost sight of, we venture to think.

We do not find anything for special comment under the heading "the Theory of the Sample Tree" though the subject is clearly presented, and the same applies to the mean basal area and mean height of a stand. We also get no very definite suggestions on that rather moot point, the most suitable number of sample trees to take under a given method, but the author repeatedly puts forward the view that it is better to limit severely the number of points through which a curve is to be traced, such points being the average of the measurements of a pair or group of similar sample trees—in which we agree with him—and that it is also best to choose the maximum and minimum of the possible range for such a pair, rather than to attempt to choose both trees nearer the usually estimated mean—of which we are not so confident; the theory that there is a smaller personal factor by the former alternative is perfectly correct; but the deduction is very questionable that thereby closer approximation to the desired mean is obtained, extremes being by their very nature abnormal and erratic in their occurrences. (The example on p. 59 chances to support the author in this matter, but it is partly chance and all conditions were probably favourable in his plot.)

The sample plot measured was of 80 years old *Pinus sylvestris* with 180 trees over 1¼ acres. Every tree was fully measured up in two metre lengths after felling, so that any tree or trees could be considered as samples for determining the volume of the rest by any selected method.

After pointing out the well-known inaccuracies of the Arithmetical Mean Sample Tree Method, eight methods of group-formation are in turn critically discussed with examples using actual sample trees and the author finally recommends for crop measurements, that in which each diameter class is taken as a group, the errors being in both directions and so cancelling ; in the example worked out the calculated volume differs from that measured after felling by only 0·1 per cent. For permanent sample plots it requires too many sample trees.

Passing on to "Abstract Sample Tree Methods," *i.e.*, those in which the volume of the crop is not calculated directly from the measurements of the actual sample trees, it is pointed out that in the group methods already dealt with, the volumes of trees of the calculated mean basal area or diameter for each group can be obtained directly from volume tables compiled from large numbers of trees and so more likely to be representative than any selected sample tree. Provided the volume table is applicable, very accurate results are obtainable, especially by the single diameter class method, but the difficulty is to show whether the available tables are really applicable, for volume tables, even when by height as well as diameter classes, do not provide for variation in form which itself certainly varies considerably with locality, age, and method of treatment. Form factor curves are considered by the author as very little if any better than volume curves, though he does not make his point too clearly before going on to the graphical methods by which volume and other curves are drawn for each plot on the basis of measurement of actual samples.

The volume curve method is held in rather too facile a fashion to be open to the same objections as volume tables and Schwappach's method of drawing height and form-factor curves separately is held to be no improvement unless the volume curve is also drawn and the three 'cooked' till they conform to the formula V = ghf. Dehra Dun follows what is virtually Schwappach's procedure, but is criticised for not keeping the first groups equal in successive measurements, and for probably wasting time over 'back check' in the attempt to make use of former sample trees at subsequent

remeasurements. Incidently, faulty procedure is also pointed out in that by treating each of the two diameters measured on each tree as a separate tree till the last step in the calculations of volume, etc., per acre, mean diameter is virtually being taken as $\sqrt{\frac{d_1^2+d_2^2}{2}}$ which involves twice the error of the arithmetic mean $\frac{d_1+d_2}{2}$, in giving the true basal area of the elliptical bole. The extent of this error is illustrated by the figures for an ellipse with axes of 18 and 20 units: the true area is 90; the area from the girth assumed to enclose a circle is 90·375, the area from the mean of two diameters 90·25 (*i.e.*, better than the girth method) and the area from the mean of the squares of two diameters 90·5 (less nearly correct than the girth method).

The volume line method in which the volume of the samples is plotted against their basal areas is recommended as the curve, being a straight line, is easy to draw, and can be treated mathematically, but the assumption involved that *hf* is constant requires further consideration.

Schiffel and Schuberg introduced the idea of *Form Quotient* into their volume tables to make them applicable to crops with varrying form, and Mr. Chaturvedi proposes to base on it a new method of determining crop volumes. The *Absolute* Form Quotient is the ratio between diameter at breast height and the diameter at half the height above breast height. He first shows that it is permissible to take it that the volume of a tree divided by the product of its height, basal area and absolute form quotient, is constant, and determines crop volumes by tracing a form quotient curve and a height curve from measurements of standing trees, felling but one sample tree for each of three groups with approximately equal diameter range. The volume of the actual sample is adjusted to that of the mean sample of the group by proportion. The drawback is admitted that the diameter at half height of a number of trees (30 for one plot) must be measured and in our opinion, the author unnecessarily leaves his case weak by omitting examination of the possible accuracy with which this can be done,

contenting himself with referring to Müller's book on Mensuration (third edition, p. 210). If one turns up this reference, one finds a table of results obtained by Schiffel from which it appears that the error in diameter may only be about 1 per cent, and that in basal area about twice as much, and though the author's example works out within ½ per cent of the measured volume, equally close approximation is possible by the volume curve or volume line methods. We suspect that doubts on this very point which the author could perhaps have removed will result in the new method—despite its sound mathematical basis—being adopted by but few workers in this field.

The foregoing criticisms notwithstanding, this Memoir will serve a very useful purpose, bringing together and examining critically the various methods concerned in sample plot work in an admirable and lucid way, much better than any other work known to us either in English or foreign languages. Data of complete measurements of all trees on a good sized plot are most valuable; the author has made very good use of them and now makes them available to others permitting the testing of his deductions or their use for any other purpose.

H. G. CHAMPION, I.F.S.

STUDIES IN WESTERN YELLOW PINE NURSERY PRACTICE.

This article by Donald R. Brewster and J. A. Larsen, both of the American Forest Service, which has been reprinted from the Journal of Agricultural Research, Washington (Vol. XXXI, No. 12, December 1925), is an interesting contribution in that many of the conclusions reached should be found to be applicable to general nursery practice and not only to the cultivation of Yellow Pine (*Pinus ponderosa*). The field of investigation includes only four main factors, namely :—Depth of soil covering, methods of sowing, degree of shade and the quantity of watering required, with or without working of the soil. Of these the first two are the most interesting since the two latter would tend to vary more with changes in species and locality.

The most interesting of the results obtained is that concerning the method of sowing, as it was found that broadcast sowing was in many ways preferable to sowing in drills, since the highest germination and survival per cents, the superior development of the survivors and the consequent economy in seed were all obtained by broadcast sowing. The crowding together of seedlings in the drills appears to increase the danger of damping off, while the competition between individuals causes unnecessary elongation of the stem and taproot with a corresponding sacrifice in robustness. Objections to broadcast sowing which still stand and which were not investigated in the article under review are the greater difficulties attendant on weeding and also the slightly increased difficulty that is experienced in lifting the seedlings for transplanting purposes. An exception to these conclusions, however, is to be found when drought is a danger and when watering is impossible or expensive, in which case sowing in drills accompanied by continued and thorough working of the soil is proved to be very beneficial, for this working of the soil is more or less impossible in the case of broadcast sowing. In addition it would appear reasonable to suppose that this exception could be extended to those stiff soils where soil aeration is of particular value and to those species that are intolerant of any lack of aeration.

As regards the depth of the soil covering over the seeds it was proved conclusively that the lighter the covering (*e. g.*, $\frac{1}{8}''$ to $\frac{1}{4}''$) the better, a more rapid rate of germination, a larger germination per cent., less damping off and a generally more healthy development at such depths being obtained. This refers to pine *seed and it would be reasonable to suppose that the optimum* depth for sowing would increase or decrease more or less proportionally with the size of the seed sown; but this should of course be found by experiment for each species.

As far as shade is concerned the investigations proved that complete freedom from cover, even temporary shade during the driest months, was entirely beneficial as long as watering was carried out. This seems hardly surprising as pines are, as a rule, strong light demanders and intolerant

if shade as well as being hardy. The experiments do not seem to have included any investigation into the effects of side shade, which might prove valuable for protection against dessication where watering is expensive, while the more suppressing effect of temporary overhead shelters would be avoided.

A point about the report that is worth noting is the thoroughness with which the work was carried out, the care with which disturbing extraneous factors were eliminated and the consequent concentration on the actual objects in view to the exclusion of others which have been left for subsequent experiment. This thoroughness enhances the value of the study considerably and is a characteristic of the experimental work of the American Forest Service that is to be warmly commended.

EXTRACTS.

RECRUITMENT FOR INDIAN SERVICES.

The structure of dyarchy originated by the Government of India Act, 1919, was carried up another story by Statutory Rules and Orders, 1924, Nos. 354 and 355, issued by the India Office. By those Orders the control of the servants of a local Government was put in the hands of the local Government up to and including the power of dismissal "for good and sufficient reason." The local Government was thus put in a position to secure due diligence on the part of its servants. At the same time, for the protection of the servant from victimisation, these Orders prescribed appropriate inquiry before the infliction of any punishment and set up a suitable system of appeal. The Government of India is the most usual appeal body, and it is interesting to note that special machinery for dealing with such appeals has recently come into being by the appointment of the chairman and other members of the Public Service Commission.

The control of existing servants being in the hands of the local Government, it only remained to transfer to the local Govern-

ment, the power of making new appointments. This is done by Statutory Rules and Orders, 1926, Nos. 390 and 391, recently issued.

Within certain reasonable and necessary restrictions, these Orders give the local Government a free hand as to method of recruitment. In this the Orders go beyond the recommendation of the Lee Commission, and rightly. The Lee Commission recommended that in any recruitment by a local Government the Public Service Commission should determine "the standards of qualification and the methods of examination." In an article in our issue of July 12th, 1924, entitled "Europeans in the Indian Services," we pointed out that that recommendation violated the principle of provincial autonomy, and it is very fortunate for the future of dyarchy that the new Orders make the local control of the transferred services effective by transferring also in full measure the power to appoint and control the Government servants engaged in the administration of these services.

In one point only do the Orders show any distrust of dyarchy. The local Government is prohibited from lowering the standard of admission without the previous sanction of the Governor-General in Council. It is not clear why it should be suggested that any local Government would have a desire to lower the standard. It is true that in India, as in Great Britain, there are always 'people of influence' going about trying to thrust their incompetent relatives into 'soft jobs,' but surely the local Government of a Governor's province is sufficiently strong to deal with these people without this particular piece of support. This lack of trust is a universal characteristic of our nation; each of us is perfectly convinced of his own impeccable honesty, but at the same time considers it necessary that his neighbour's honesty should be safeguarded.

This, however, is the only blemish, and it is a slight one. For the rest, the local Government is given all the freedom a reasonable local Government could ask. It is free to recruit in any manner it pleases, so long as it does so by means of a competitive examination or on the advice of a permanent board of selection set up by itself.

At the same time, the position of an existing servant is safeguarded by the condition that any appointment that would adversely affect him requires the previous sanction of the Governor-General in Council. This very effective safeguard, along with the Orders regulating dismissal, should completely allay the fears which the Indian civil servant has sometimes felt as to the security of his position.

These fears have never been shown by the young men at the British Universities who furnish the recruits. The true state of affairs is masked by the fact that at the present time the London competition selects fewer Europeans and more Indians than in pre-War days. Because of this, people jump to the conclusion that our Universities are no longer prepared to send their best to India. That is wrong. They send their best to the competition as much as ever they did. The study of the university records of the European Indian civil servants recruited now and before the War shows the standard of the present-day entrant to be fully as high as that of the pre-War entrant. The true explanation lies not in the deterioration of the European candidates, but in the improvement of the Indian candidates.—[*Nature.*]

INDIAN PANELLING AT GENEVA.

SIR,—In the message from Geneva in your columns reporting the official opening of the new building of the International Labour Office it is stated that the guests "admired the splendid oak-panelled council hall presented by Great Britain." The fact is that the panelling is of Indian laurel wood, and is the much-appreciated gift of the Government of India. Moreover, while the furniture of the council hall is of British make and the gift of his Majesty's Government, the valuable timbers of which it is composed are also from India and presented by her Government. The trade in Indian timber, other than teak, for decorative and furnishing purposes has been developed since the war, and there are many fine examples of its use in this country, notably at the offices of the High Commissioner. The fact that India made so beautiful and substantial a contribution to the new

offices of International Labour ought not to be overlooked. As the High Commissioner suggested in his brief speech at the opening ceremony, it will symbolize the consideration that the International Labour Office is concerned with industrialism in Asia as well as in Europe and America.

London, June 15th. F. H. BROWN.

[*The Times.*]

FOREST DEVELOPMENT IN MADRAS.

SUPPLY OF SLEEPERS.

Lord Goschen Reviews Government Policy.

Presiding over the Forest College Prize-day celebration meeting, His Excellency Viscount Goschen in the course of a speech on the forest policy of the Local Government, said much attention had been paid to the preservation of forests and silviculture, and too little attention to the development of the business side of the industry. His Excelleney referred to the timber shortage during the War when India was not able to supply it and thus lost the opportunity of increasing its forest revenues, and explained in detail the developments made in the Madras Forest Department in logging engineering. His Excellency made an appeal to the people of this province to support the Government in the forward policy of the Forest Department.

Continuing the Governor said the Railways have asked us to supply sleepers and if we are unable to do so, they will have to turn to outside sources for their supply. I have myself been approached by another country where no timber is grown to ask whether we can supply railway sleepers in large numbers for railway development and timber suitable for building. Financial support of this industry at the moment will, I am sure, bring in good interest in future.—[*The Pioneer.*]

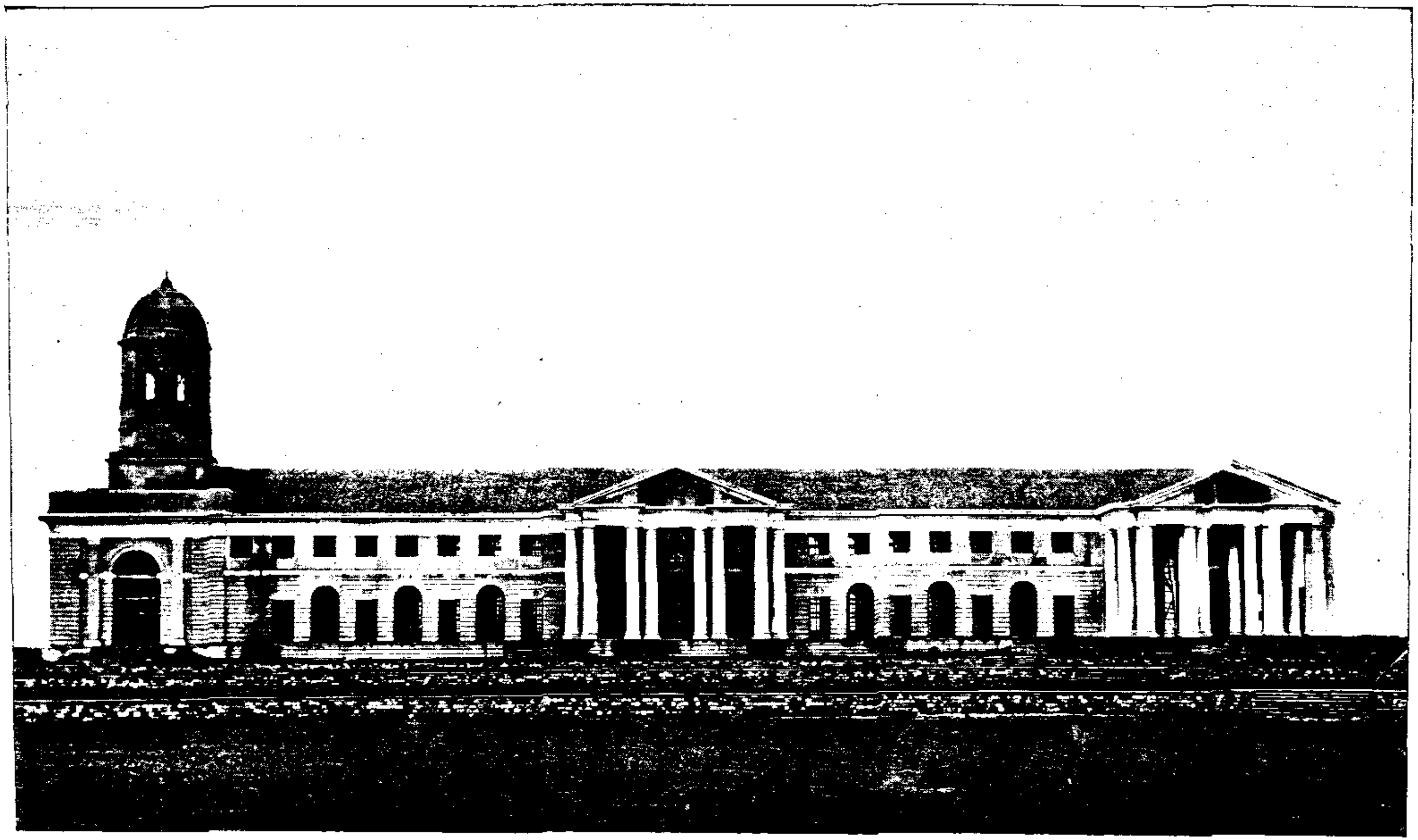

Photo by I. N. Sharma.

East wing of the Main Building of the New Forest Research Institute at Dehra Dun.
Photographed on 25th July 1926.

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THE RAILWAYS AND THE FORESTS.

These brief notes are the outcome of a trip to Simla in July this year, where I was deputed (with the Conservator of Forests, Eastern Circle, U.P.) to negotiate and arrange for the disposal of all Railway sleepers coming from the U. P. forests in the coming year, and where we had the opportunity of meeting nearly all the Railway Chief Engineers in India.

What impressed me more than anything was the extraordinary lack of co-ordination between the Railways and the Forests. Let me give a few examples. One Chief Engineer said to me "Down our way the name of the Forest Department is mud with the Railways." There must be something radically wrong when the chief consumer and the chief producer of an article regard each other in that light. Another Railway Engineer urged that the Forest Department should have a fixed royalty for the sleepers, whether the forests adjoined a railway station or were 200 miles away, an economic impossibility that any Forest Officer could have pointed out in two minutes' conversation. There is undoubtedly an impression amongst Railway Engineers that the share received by the Forest Department of the total value of a sleeper is excessive (one Chief Engineer described it as "iniquitous"). This again is an economic fact over which the Forest Department have usually not much control, since the value of the timber is fixed entirely by the law of supply and demand. The value of timber,

whether sleepers or for the public demand, is fixed by the total demand at the principal markets, and it is not possible to have one price for the Railway sleepers and another for the general public, any more than for say steel or corn or oils. What the Forest Department get for the standing timber is the residue from this gross value of the sawn timber after deducting costs of felling, sawing, extraction and contractor's profit. This residue may vary from a pice a cubic foot (*e.g.*, timber from the inaccessible and low value fir forests of the Himalayas) to 16 or 20 annas a cubic foot for the more accessible and more valuable forests of teak or sal. Even for sal, there are forests so inaccessible that the costs of extraction leave nothing over for royalty or net value of the standing timber, and are therefore unworkable. Another Chief Engineer had widely advertised and ultimately placed an order for a large number of first class B. G. sal sleepers with a middleman in the United Provinces, who had failed to supply, and he asked me why. I explained that under the system in vogue in the United Provinces, every single B. G. sleeper made in the U. P. forests is first examined by a Forest Officer on behalf of the Railways and passed or rejected, and that a middleman cannot possibly get B. G. sleepers except from our rejections, and to place orders with such middlemen was futile. I had to admit that forest officers in the United Provinces do not usually see the trade advertisements, and I think that some forest officer in every province certainly ought to do so. Another Chief Engineer was very keen on putting up a sleeper creosoting plant, to deal with timbers for which there was at present no demand, but had so far not been able to get any figures of quantity and cost of outturn from the Forest Department ! Another Chief Engineer of a Railway in the U. P. had recently called for tenders for a large order (several lakhs worth) of timbers of various sizes. No Forest Officer in the U. P. was even aware of this, although it was widely advertised in the *Indian Trades Journal*.

In the United Provinces we have done something to try and remove this stigma of lack of co-ordination, and as far as sleeper supplies are concerned, the organisation is functioning quite

satisfactorily. It might be of interest to Forest Officers in othe provinces and Railway Engineers to explain what the system is. Throughout the U. P. forests there are no long-term leases. In the sal forests, the trees marked in the previous cold weather are classified and divided into suitable lots, which are put up to public auction during July and August. These lots are of course not exclusively for sleepers, they produce all the sal timber for the general market. The Divisional Forest Officer makes an estimate of outturn of sawn timber from each lot, and puts down 25 to 35 per cent. as probably available for sleepers (the balance going to the ordinary timber market). With these figures collected, the Chief Conservator of Forests, U. P., or some one deputed by him, goes to Simla early in July to attend the Railway Sleeper Pool meeting, and either informally over a bottle of beer, or more formally at a Pool meeting, fixes up the rates and quantities of sleepers to be supplied to the different railways. I must here emphasise that *our procedure is not designed or intended to force up prices against the Railways.* We have occasionally had to resist a tendency to reduce the price below the general price ruling in India, but this is rather the exception, and this year we found that having offered the sleepers at a fair price, most of the Railway authorities concerned frankly and cheerfully accepted. We left Simla empowered by the Railways *to place orders on their behalf with the purchasers of our coupes* for nearly 4,00,000 sleepers of all sorts, to a total value of nearly Rs. 14,00,000, *i.e.*, for every sleeper offered. These are then divided up amongst the Divisional Forest Officers concerned, who allot definite numbers of sleepers to each sale lot. At the auctions, the prospective purchasers of our timber lots know beforehand that they are assured (under our guarantee) of a sale of about 30 per cent. of their outturn at a satisfactory price. In due course, when they start sawing up the trees and have to start paying instalments of the purchase price of the lot, they are actually financed very largely by these sleeper contracts. That is to say as a contractor gets his sleepers ready, and passed at the station, the Divisional Forest Officer credits his instalment account with the full value of the sleepers delivered. The Railways give letters of credit

and cheque books to the Divisional Forest Officer who periodically draws two cheques:

(1) to Self for credit to revenue, to settle off what the contractor owes for instalments, and

(2) the balance to the contractor.

Note the advantages of the scheme to all parties concerned. The contractor knows before he purchases a timber lot that he has a safe sale for a proportion of the produce, and that he is given full credit by us for the sleepers as fast as he can produce them. The Forest Department are relieved of all anxiety about recovery of instalments during the financial year. This system of financing by sleepers also undoubtedly brings in numbers of the smaller type of contractor, who is content with a smaller profit, and the increased competition certainly has resulted in higher auction bids in recent years. In fact our chief trouble now in the United Provinces is *overbidding* at auctions. Divisional Forest Officers in the Western Circle never have to urge up the bidding for sal timber lots, but now and then have to stop the bidding as being excessive, and so much above the value of the lot that the purchaser is bound to suffer loss. The Railways have the advantage of eliminating the unreliable middleman (even the *reliable* middleman is after all only a sort of parasite); of having the Forest Department guarantee regarding quality, (we examine and pass *every* sleeper, not 20 per cent or 30 per cent as some Railways do), and for our own reputation our passing is undoubtedly *severer* than most Railway passing. Also the Railways know that the Forest Department must know better than wandering and casual middlemen the numbers of sleepers expected, and also have naturally a much greater authority over the contractors to see that the requisite numbers are made. Not that there is normally any necessity for compulsion in the matter (if there was, it would mean that the prices were too low or the passing too strict), but great activity and rising prices in the scantling market, for example, would tend to influence contractors to saw up the trees into scantlings rather than sleepers, and having placed orders on behalf of the Railways, the Divisional Forest Officers naturally see that contractors do not attempt to

back out of their agreements subsequently. Generally speaking it is difficult to conceive of a more satisfactory system to all parties concerned—except of course to the middleman, who is entirely eliminated. We hope this year in the United Provinces to explore the possibilities of extending the system to other classes of timbers (besides sleepers) required by the Railways. The appointment by the Railway Board of a Timber Advising officer was undoubtedly an excellent step in the right direction to place the Railways and Forest Department in closer contact. Another excellent innovation adopted by the northern group of Railways is to insist that every tenderer of large supplies of timber should produce a certificate from the Conservator of Forests that the tenderer has a lease or control of a forest area and is in a position to supply the timber for which he is tendering. This eliminates the peripatetic middleman who tenders for a gamble. Another suggestion is that forest officers should obtain copies of Railway tender notices, and either inform the Railway Engineers of reliable contractors (who have bought forest leases or timber lots) who are willing to supply, or the forest officer could even act as an intermediary and help to fix up contracts between the Railway and the timber contractors, and help to see that the contracts were duly carried out.

E. A. SMYTHIES, I.F.S.

AN EXTRAORDINARY BAMBOO COUPE IN THE LANSDOWNE DIVISION, U. P.

Lansdowne Division is the home of bamboos (*Dendrocalamus strictus*) in the United Provinces, and by far the best bamboo crops in the Division are to be found in Kotdwara Range, which is very fortunate in having Kotdwara railway station of the E. I. Railway situated in the centre of it. In Kotdwara range the best crop is to be found in Paniali block, which is an almost level piece of practically pure bamboo forest of a gross area of 596 acres, of which perhaps 400 acres are forest and the remainder practically bare river beds. The bamboos in this area seeded gregariously about 1910, and the present crop, which resulted

from that seeding, was thus about 15 years old when it fell due for cutting for the first time in 1925-26. The crop was so extraordinarily dense that it was almost impossible to force an elephant through it, and it was so dark underneath that many clumps were being killed out by suppression and lack of light, although the tree crop of mixed miscellaneous species above the bamboos had previously been cut back so as not to occupy more than one-third of the crown space.

When this crop fell due for cutting there was some discussion as to whether it would not be better to cut such a valuable crop departmentally in order to minimise the almost inevitable damage from bad cutting on the part of contractors; but, as departmental work is very rarely satisfactory and labour is very difficult to obtain and control, it was finally decided to put it up to auction with the provisos that one or two special rules should be imposed, and that none but reliable contractors should be allowed to bid. When the auction was held the bidding was extraordinarily violent and the contractors were so keen that the coupe could easily have been sold for a fantastic sum, partly because the area was so near the rail-head and so easy to work, and partly because the area, not having been worked over for 15 years, provided all the elements of a gamble so dear to the lump-sum contractor's heart. In fact none knew what the outturn would be, so an effort was made to check this wild bidding when the figure had gone to 50 per cent over the estimated value of the coupe. With great difficulty this was done, and the coupe of 400 acres of bamboos was finally sold to one of the leading Najibabad contractors for Rs. 23,200 or Rs. 58 per acre.

The ordinary rules for the cutting of bamboos as laid down in the Working Plan of Lansdowne Division are as follows:—

(1) No cutting of culms may be allowed in the year of their flowering, but they may be cut anywhere under proper sanction after they have shed their seed.

(2) No shoots of the last rains may be cut.

(3) No digging or extraction of rhizomes may be allowed,

(4) Culms may be cut only at a height of from 6′ to 1′ above the root except in cases of congested clumps where cutting must be done at the lowest possible point.

(5) The use of sharp implements is insisted upon in order to avoid tearing and splitting the stumps of the culms.

(6) Cutting may not be allowed in two operations.

In addition to these the following extra rules were imposed for this coupe :—

(*a*) A special man to be appointed by the Department to supervise and control the work.

(*b*) Cutting to be done progressively from one side of the coupe to the other.

(*c*) No bamboos to be cut from clumps containing four or less culms.

These extra rules were devised to meet the special requirements of this particular coupe and it is interesting to see in how far they served the desired end.

Rule (*a*).—A Deputy Ranger was put in charge of the work, and, although at times his control was much weaker than it should have been, his presence on the spot kept the depredations of the contractor's coolies largely in check, particularly as regards high cutting provided for in rule 4 of the ordinary bamboo cutting rules. In fact, when the work was finally completed, it is safe to say that practically no high stumps (the primary cause of congestion of bamboo clumps) were left in the area, and this is the first time this has ever been done in the history of the Division.

Rule (*b*) —The idea of this rule is that the contractor's men should be allowed to work only in one part of the coupe at a time, thus making it infinitely easier—this is particularly the case in a mountainous coupe—to control the work. In theory this is a very sound rule, but it was found to be almost impossible to enforce effectively in practice owing to the system under which contractors carry out their work. The trouble is that bamboos of various classes (referred to in a subsequent paragraph) are cut and different labour is employed for cutting the different kinds

of bamboos. The quicker the bamboos are put on the market the greater the chance for a contractor to steal a march on his rivals in sales, and this particular contractor, being a very astute business man, naturally made a great effort to extract his material quickly, with which object in view he kept a number of gangs working at once. It was impossible for these gangs all to work in the same place at the same time, so that friction naturally arose over the working of this rule. It was soon realised that the contractor had strong arguments on his side, and finally it was decided not to enforce the rule strictly. In fact in bamboo coupes it does not seem to be fair to attempt to enforce this rule however much it may seem desirable to do so in theory.

Rule (*c*).—This rule was not of much importance in this particular area, where the bamboos were far too dense and where clumps of four or less culms were nearly all suppressed, and should have come out originally in thinnings—if such were done in bamboo forests. The rule was therefore not strictly enforced, but in a more open forest the rule would be of much more importance.

Of the three special rules devised, therefore, only the one appointing a special man to control the work proved to be of value, and it would appear that this is the only way of effectively controlling high cutting. As the work progressed, however, it became apparent that another rule should have been included, and that was that a wind-belt should have been maintained on the exposed side. As this very dense forest became suddenly opened up large numbers of new culms, which the contractor is not allowed to cut, began to fall over from their own weight, particularly in March when the new leaves appearing on these new culms made them more top-heavy than ever. By the end of May about 20 per cent. of these culms had been blown over, or had fallen over by their own weight, and, had there been a really bad storm, practically the whole forest would undoubtedly have been blown flat. It would thus seem that when a dense bamboo forest is cut over for the first time a wind-belt should always be maintained for the protection of the new culms left standing.

Another point of interest in this coupe was the large number of dead culms found in living clumps. Much of this was

undoubtedly due to excessive density of the forest, but there were also many signs of insect attack and this insect is now being studied by the Forest Entomologist. The removal of these dead culms was essential if the low cutting to prevent congestion was to prove effective, and the contractor could not be forced to do this as such dead bamboos were of no value to him and there was no condition forcing him to cut dead material. A cultural operation was therefore carried out in June, just before the break of the monsoon, in order to remove these dead culms which tend to increase congestion—although they hold up the new culms—and also to remove the worst of the blown-over new culms. Part of the area was treated in this way in June and the remainder will be done after the monsoon, with the idea of testing whether such cultural operations are better done before or after mon-soon.

The work was started in November and finished by the middle of March the outturn figures being as follows :—

Kind of bamboo	Length.	Number of scores.	Description and use.
Charhao	15′	864—11	Thick. Used in making cart and tent poles and ladders.
Chharh	12′—15′	3,794—18	Less thick. Used in making carts and lances.
Bahins	7′	23,129—18	Thick. Used for beds.
Sarainchas	12′		Thin Used for roof work.
Kaprail	15′		Thin Used for baskets, chicks, etc.
Kanderu	10′	14,471—6	Thin. Basket and roof work
Lathis	7′	3,412—13	Medium. For making sticks and lathis.
Miscellaneous ...	...	1,646—14	
Total ...	...	47,320 scores	

It is thus seen that the contractor obtained 47,320 scores of mixed bamboos for Rs. 23,200, or roughly eight annas per score, which is not a high figure considering the extreme accessibility and ease of working of the coupe. He claims that he is in loss but it is significant that he has since started to build a large house in Lansdowne.

The object of writing this article is largely to draw attention to the great potential value of bamboos as a species for afforestation work. The life of *Dendrocalamus strictus* is said to be 40 years, and it matures for cutting after 16 years. The cutting rotation is four years so that a bamboo forest will produce yields in the 16th, 20th, 24th, 28th, 32nd and 36th years, or six yields in all, after which it will seed and reproduce itself naturally. An average rotation of sal is 120 years, or three life cycles of bamboos, during which period the latter species will produce 18 yields. Taking the case of the Paniali bamboo forest of 400 acres, it may safely be assumed that the crop will sell for Rs. 20,000 at each rotation or Rs. 20,000 × 18 = Rs. 3,60,000 during the 120 years the sal forest takes to reach maturity. It is doubtful if any sal forest in the United Provinces of 400 acres would sell for Rs. 3,60,000 or Rs. 900 per acre*, and when it is remembered that the yields from bamboo forest commence after 16 years, and that the bomboo reproduce themselves naturally whereas the sal very rarely does, it becomes clear that *Dendrocalamus strictus* is a species which should have a great future in afforesation work in the United Provinces.

F. W. CHAMPION, I.F.S.

THE CONSTRUCTIVE PROPERTIES OF FIRE IN CHIL (*PINUS LONGIFOLIA*) FORESTS.

In view of the fact that the Siran Chil forests of the Siran Valley of Hazara have recently been brought under a revised and regular working plan, I am much interested in a proposal to employ fire in areas under regeneration as a protective and natural cleaning agency. The Siran forests stand mostly on gneiss which provides a very deep sandy soil full of boulders. The soil and all other conditions are entirely favourable to the chil with the result that the growth is generally first quality.

Up to 1922 the forests had been subjected from time immemorial to periodic summer firing. The earliest records are

* Mr. Champion appears never to have heard of the prices realised in Gorakhpur.— [HON. ED.]

provided by the writings of Cleghorn and Stewart who visited this area about 70 years ago. They exist moreover in a tract which came under the full influence of the Aryan invasions of India and which according to history has been well populated for the last 2,000 years. Summer fires cannot, therefore, be in any way regarded as a recent phenomenon. Judging from the accurate records maintained for the past 20 years the firing incidence has been about once every three or four years.

The "coppicing" powers of the chil seedling after firing are well known. In this tract early height growth is rapid, and the formation of the present forests seems to have been accompanied by a succession of summer fires cutting back the young growth until the root system had become strong enough to throw out in the rest period a shoot high enough to be out of reach of fire. The process also suggests nature's method of cleaning a sapling crop. Only the strongest plants would survive, the resulting crop being sufficiently thinned out to obviate in the earlier years any unnecessary accummulation of inflammable material. It is obvious that light, resulting from an adequate canopy espacement, is essential to success. I have no hesitation, therefore, in saying that every tree in the Siran has resulted from a "coppice" shoot, the stocking throughout being unevenaged, owing to the past fellings, but uniformly full.

The danger resulting from the complete elimination of fire from seedling crops is exemplified by one compartment in the Siran which has not been fired since 1914. Here the regeneration in open spaces forms almost impenetrable and highly inflammable
waist
thickets, waste to shoulder high. Exceptional fierceness in a summer fire resulting from weeds and other inflammable material is known to destroy the coppicing properties of the plant, and there is grave danger that if an accidental or incendiary summer fire should occur in this compartment, which has been unnaturally protected, the whole crop might be destroyed. Such destruction is obviously undesirable in areas under regeneration where advantage has been taken of the existence of such advance growth to indulge in a somewhat severer opening of the canopy.

Areas not under regeneration in the Siran are now being fired departmentally in the winter on a three years' rotation the protection thus provided from summer fires being to date very satisfactory. It is proposed now, therefore, to extend the same form of protection to areas under regeneration. Experiments have begun, but no accurate data have yet been produced. The fact that the old firing Incidence corresponds roughly with the incidence of chil seed years suggests that the correct procedure will be found in the careful firing of regeneration areas in the winter preceding a seed fall.

Regeneration is profuse, and a certain amount of cutting back or even destruction should be welcomed. Grazing, not browsing, is meanwhile to be encouraged as being obviously a beneficial factor in removing excess accumulation of grass and weeds.

The nominal regeneration period of the Siran plan is 25 years, and ample for the purpose despite the proposed periodic winter firing. A village forest in the neighbourhood in which an unintentional seeding felling of a heavy nature took place in 1901-02 had been replaced by 1921 by a sapling crop out of reach of fire, despite the fact that five summer fires are recorded as having swept the forest in the intervening period. I believe, therefore, that in introducing this proposal into the Siran, I am merely re-establishing a modified form of the environment to which the forests owe their origin.

But in this matter I feel I am somewhat up against previous ideas as given in text books. Thus although Professor Troup in his "Silviculture of Indian Trees" naturally mentions the power of resistance to fire displayed by the chil and describes how this is attained, suggests nowhere that it has adapted itself to fire and that fire may be a necessity or a constructive agent in its silviculture. While he points out that in certain localities fire is non-injurious the reader I think will finally come to the conclusion that fire is an evil responsible perhaps for twist (of which there is very little, if any, in the Siran) and in many cases for failure of regeneration; in fact that "under ordinary conditions

fire may be regarded as the most destructive agency with which natural reproduction of the chir pine has to contend."

After, however, some nine years' acquaintance with two very different types of chil forest, *viz.*, those of Rawalpindi and Hazara, I would like to hazard the opinion that fire is not an original destructive agency except possibly on steep slopes, and even here it is only destructive in that it delays establishment of the young crop. The primary destructive agencies are the axe, grass cutting and any incorrect management leading to conditions in which fire can assert itself as an evil, *e.g.*, closure to grazing with the resulting accumulation of inflammable material.

Other statements both in this work and by other writers on the Himalayan conifers, with which I have mainly had to deal, have forced me to the conclusion that our management has hitherto been based on pussyfoot principles. Excessive indulgence in alcohol is no argument for total prohibition. The same applies to fire and grazing and perhaps other natural phenomena to which our forests have been subjected for centuries. We talk glibly about following nature and forget that the nature we are visualising may be an European nature inherited from our training and not an Indian nature. We naturally regard fire and grazing as destructive agencies. We, therefore, intuitively welcome the proof provided by the few cases in which they are so and by inductive reasoning arrive at general conclusions which may be incorrect if not dangerous. Doth not the fool say in his heart, there is no God ?

E. A. GRESWELL, I.F.S.

CONVERSION TO THE SHELTERWOOD SYSTEM IN THE SAL FORESTS OF THE U. P.

Seeing year after year the results of the working of the sal forests in many leading Divisions of the United Provinces under conversion to the Shelterwood system, I feel doubtful as to our achieving the object aimed at. The oldest plan under this system in this province is Mr. Collier's Haldwani Plan, which was introduced in 1914 as an experiment. This Plan was based on

original theories and reasonable expectations, rather than on any definite knowledge about obtaining regeneration where there is none at the time of regeneration fellings. It is well known that sal regeneration generally does not come up in the same way everywhere although the conditions may seem to be identical. The above mentioned plan has been in force now for over ten years and there are no satisfactory instances either in the Haldwani Division, or any other place where this system has been followed, to show that regeneration has been obtained as a result of our fellings on any considerable scale. Small accidental patchy bits, here and there, the reasons for the appearance of which are not definitely known, are not deciding factors, since at the present stage of our knowledge about sal the results of one locality very often cannot be repeated in another locality under apparently similar conditions, however much we may try.

So far as I have had the opportunity of seeing the felled areas in the submontane divisions it appears that the regeneration is far behind the fellings. If the same conditions prevail in other sal forests of the U. P. treated under this system, I am afraid we are cutting in excess of what we are creating. To quote Mr. Trevor *vide* his Practical Forest Management, page 49, "In the shelterwood system it is essential that the regeneration areas be regenerated in the specified period and that the progress of regeneration should keep pace with the progress of the fellings, otherwise the whole structure of the working plan falls to pieces." How far we are achieving this last aim in particular is a matter of serious consideration, whereas instances of turning good sal forests into very open crops consisting of seed-bearers widely spread, abundant weeds and grasses and a little regeneration only here and there, in no way better than the adjoining unfelled areas, are extraordinarily numerous. From these experiments, however, we have gained one useful knowledge that sal regeneration, if it is present at the time of fellings, whether established or unestablished, can be developed satisfactorily by cutting it back after the fellings and burning the area before the spring, which results in a good growth of coppice shoots, but the more difficult and as yet unsolved problem is, how to obtain regeneration where it is absent.

Operations like sowings and plantings or even wounding the soil, prescribed in the plans, are mostly out of the question on any large scale, for want of funds and labour in the hot weather, or beginning of rains, in most of the sal forests. The working of the sal forests under this system beyond the stage of experiment with our present meagre knowledge about getting regeneration, seems unsafe, until we acquire the necessary knowledge about regenerating a given area within the prescribed period, with the same ease as we have command over the fellings. I admit that none of the regeneration periods have yet been completed and there is room for hope yet, but the results of the extensive fellings and the unsatisfactory progress of regeneration during the past decade show that we are not keeping pace with the fellings. As sal comes up in patches of more or less uniform groups naturally, it seems that the Group Method would be a good compromise between the old selection and the present shelterwood system for sal. It would avoid the risk and wastage of the present system and would improve the management and quality of the timber as compared to the old system.

Another disappointing feature is the enormous wastage of small size timber and fuel left in those felling areas that are situated away from towns and railways, where the high cost of export prohibits the full utility of the outturn resulting from these concentrated fellings. Taking an economical view, it would have been better to have limited this system for the present to the sal forests of the plains, where both the means of export and the demand are more favourable and the timber as well as fuel is better utilized in consequence. The system might have been introduced to the difficult submontane divisions of the Western Circle in due course, along with the progress of our knowledge as well as the development of cheaper means of export, like tramways, on which the future of the U. P. forests so greatly depends. Thus not only could the wastage of the large quantities of small timber and fuel have been saved, but the danger from fire and insects would have been reduced, while the revenues would have been enhanced, by the fuller utility of the produce, to a greater extent than at present.

I do not mean to attack in any way the advantages of the system, but this is what I see and feel with due respect to those who are responsible for its introduction. It is quite possible that in due course of time we may get over the present difficulty about getting regeneration, and then undoubtedly it will be the best method of treating the sal.

Since the above system is in vogue almost throughout the sal bearing divisions of the United Provinces, it is of vital importance to find means to develop portable tramways and saw-mills as rapidly as possible so as to take full advantage of the conversion system and its concentrated fellings. The initial cost of the above two useful works will result in early returns and is very likely to be repaid in the first or second year, if conducted on commercial lines. The cost of conversion and export is bound to decrease thereby and the revenues increase proportionally.

There is ample forest staff of all grades available and a little extra training to the few selected men would make them competent enough to undertake these works satisfactorily.

M. HAKIMUDDIN, P.F.S.

A MARCH THROUGH THE COUNTRY OF THE NAGAS AND MANIPURIS.

Early in March 1924 accompanied by a botanical collector, I toured in the Naga Hills with the object of exploring the locality from the point of view of systematic and economic Entomology. The party left Dehra Dun on the 6th March and arrived at Manipur Road A. B. Ry. at midnight of the 10th. The railway journey terminated after travelling 1,500 miles, and our road journey commenced immediately the next morning. A hand cart drawn by four Manipuris was engaged at Rs. 8 for transport of baggage and wood specimens. It was a march of 134 miles from Dimapur to Imphal, capital of the Manipur State. Conveyance by motor, though possible, was not made use of, as otherwise the opportunity of sampling the country would have been lost. This journey was performed in seven days. Although there are thirteen P. W. D. bungalows on the road, two only were

Nest of *Oecophylla smaragdina* F. on *Glycosmis pentaphylla*, Nichugad 687', Naga Hills, Assam.

Tylococcus glycosmis Green. } *Bugs*

Oecophylla smaragdina } *Ants*

used, because the time at my disposal was very limited; and halts at each stage were consequently avoided for fear of curtailing the working days. The marches were made at the rate of nine to twenty-two miles a day according to the lie of the country. The road from Dimapur to Imphal is a metalled one. Bridges of solid masonry are laid across the streams. The gradients are easy. The highest point is Mao, 5,762 feet above sea level. There is a heavy road traffic some 3,000 carts plying on the road, chiefly carrying rice to the railway station. The exports during four months (from December to March, exceeded 80,000 maunds. The journey, on the whole, was uninteresting as the hill slopes were then on fire. The Nagas burn them for *jhum* cultivation Nevertheless several species new to science have been discovered. One of them is a Coccid protected by the notorious red-ant. These ants offered a very strong resistance when twigs containing the bugs were removed. Hundreds of infuriated individuals attacked my hand, biting, stinging and pouring out acids. Two photos, one illustrating the nest of this ant, and the other a twig bearing ants and bugs together are shown.

On the evening of March 17th, Imphal was reached. It is situated in the heart of the valley and is 2,578 feet above sea-level. The area of the State is more than 8,000 square miles, of which 7,000 square miles consist of hilly and mountainous country inhabited by Kuki and Naga tribes. The Manipuris inhabit the central valley, which has an estimated area of 700 square miles only. The hills, except when cleared for cultivation, are covered with ever green forests. On some of the higher ridges, oaks and other good-sized trees are abundant. The Nagas are allowed to destroy or use the forest produce as they please. The State has an income of about Rs. 24,000 from forests, of which Rs. 17,000 is collected by the Assam Forest Department. A portion of the forests on the border of the Kabaw valley has been leased to the Bombay Burma Trading Corporation Limited.*

There are three gateways to the Manipur State. The first is the Dimapur-Imphal metalled road, the second leads to the

* Administration Report of the Manipur State, 1923-24, p. 12.

Burma frontier *viâ* Tamu and on into the Chindwin Valley, and the third is the bridle path to Cachar.

The proposal was to go to Tamu *viâ* Sebong but it fell through on account of the party being stranded at Imphal for a week, as all traffic was suspended in celebration of the Holi festival. It was only on the 27th that I was provided, through the courtesy of the Superintendent of the Hill State Office, with a gang of coolies. The party then pushed onward to a distance of 40 miles beyond Imphal. The place reached is called Shugunu. It is at an altitude of 3,000 feet above sea-level, and is situated within a distance of two marches from the police outpost of the Burma frontier. The first few miles of this road from Imphal are metalled and the rest unmetalled. The way becomes somewhat rough and rugged after Waikhong, about thirty miles off from the capital. The road runs on a slight up-hill gradient most of the way. The so-called rest house is situated on a mud-hill, as the original one was destroyed by the Kuki Nagas during the rebellion of 1917. Marks of shells are still left on the stockade which the mutineers had used as their stronghold.

A halt for two days was made here. Amongst the novelties collected in this locality was an undescribed lepidopterous species of the family Cossidæ, the larva of which bores into the living tree of *Phyllanthus emblica.*

On the 3rd April the party had to come back to Imphal for the replacement of the Tankhul coolies by men of another tribe. We then set out *viâ* Cachar for Silchar, a distance of 126 miles. This route passes over five ranges, intercepted by valleys and rivers. There are about a dozen suspension bridges of which two were under repair. The party had to wade through the stream Laimatak, cross the river Irong on a bamboo raft by means of a suspended cane cable, and the rivers Jiri and Bark by ferry. The river Irong is very deep but there is only a slight current at the point where we crossed. The Naga in charge of the raft held the cane cable with a strong grip (the ends of the cable were fixed into the rocky bank at either side) and rowed us across by giving short sharp pushes with his hands and feet.

The nine days march along this route was an exhilarating though a tedious one. Every day one had to ascend and descend several thousands of feet in a single stage. There are three P. W. D. bungalows only throughout the journey, one at Bishenpur at the 18th mile stone from Imphal, the second at Jirighat at a distance of 101 miles, and the third at Lakhipur at the 113th mile. For a distance of 84 miles between Bishenpur and Jirighat there are no rest houses except bamboo huts which were found in a very wretched condition. The hill slopes along this route are mostly covered with bamboo forests, except where clearings have been made for cultivation. The peaks are almost inaccessible and are clothed with virgin forests.

The richness of the fauna and flora deserves special investigation at the hands of an able explorer. Our collections were made mostly on our marches. This hurried survey, however, was fruitful in securing new species. Of these a new species of *Scolytus* was found boring into *Ulmus lancifolia*, an undescribed species of *Diamerus* in *Ficus elastica* and an undescribed genus of the family *Scolytidæ* in *Myristica longifolia*. Besides these the new species that have since been described from the collection are *Pseudagrion limatakensis* Fras., *Hylæothemis gardneri* Fras., *Epania assamensis* Gard., *Halme chatterjeei* Gard., *Artimpaza obscura* Gard., and *Cleomenes assamensis* Gard.

The tour which was commenced on March 6th ended on April 14th, 1924. During this short period about 500 miles of the country was travelled on foot with no guide or interpreter. The village headmen and various clans of Nagas were prevailed upon to help us by trifling presents and bakshish (for drinks of madu, a native liquor). These means, when accepted, allowed us an opportunity of getting through our work somehow. The Nagas were employed in catching insects. They collect Cicadas most ingeniously. At dusk a fire is lit and one of them stands near it and makes a curious clicking sound by beating bamboo sticks together. A few minutes elapse before the insects come flying around and settle either on his garment or on the ground near the fire.

Although detailed accounts of the customs and manners, etc., of Nagas and Manipuris are to be found in monographs especially written for this purpose a few lines on the subject will, it is hoped, not be uninteresting reading.

The earliest reference to the Manipur State is given in the epic poem, the Mahabharata, when the hero Arjuna went to subjugate the country and married Chittrangada. The date of the main story (of which the above is an incident) has been assigned by Sir William Hunter to about the year 1200 B.C. From this it is apparent that some of the Aryans migrated from Northern India and mixed with the indigenous tribes. Further evidence of this migration may be inferred from the archæological antiquities preserved at Dimapur at the foot of the Naga Hills. The relics (of which the photos are reproduced) are estimated to be 2,000 years old.

It is astonishing that Manipuris, living so close to Burma, do not profess Buddhism but Hinduism. They, nevertheless, have the general feature of the Burmese. All the men, women and children stamp their foreheads with a U shaped symbol of a yellow or creamy white colour and paint the ridge of the nose right down to the apex with the same colour. The Manipuri woman seems to be a good shop-keeper, with a healthy look and willing to work. Unlike the Hindu woman of the Northern India there is no purdah. In the afternoon she goes out openly to bazaar in a neat and tidy dress to sell her produce. There are few cottage industries. Coarse silk cloth and cotton fabrics are made and exported to various parts of India. Rice is very cheap, selling at the rate of 27 seers or 54 lbs. per rupee.

The Nagas are short, well-built people of a Mongolian type. They are divided into several tribes, *viz.*, Angamis, Tankhuls and Kukis, etc. Amongst them the Angamis dress gorgeously (a photo is reproduced). The Tankhuls are almost stark naked. The men and women alike being fond of ornaments use pig's tusks, sections of elephant's tusks, shells, etc., and wear in the lobes of the ear ornaments of reed or of metal of enormous diameter. Large Buprestid beetles of a brilliant metallic colour are sometimes tied on to their ears in place of other ornaments. The

Figs. 1 & 2. Shrines at Dimapar, Assam, said to be 2,000 years old.

Fig. 3. Naga carrying live pig to market.

Figs. 4 & 5. Angami Nagas gorgeously dressed.

staple food of the Nagas is rice. Pigs, dogs, cattle, lizards, frogs, snakes, etc., however putrid, are partaken of with relish. The weapons used by all the tribes are spears and daos or bill-hook knives. They worship queer stones that are stuck upright on the tops of hills near their villages. These stones, which are about four feet in height and two to three feet in breadth are very rough and rugged. In several places along the main road between Mao and Kohima they are laid in circles. The villages stand on the tops of hills and are well guarded with stockades. The houses are massed close together, and are built of rafters and bamboos. In some villages a pair of huge bison horns stuck on a pole serves as an altar for offering sacrifices. The tribes migrate periodically and practice only the *jhum* system of cultivation. An area five or six times larger than the area already under cultivation is cleared, and the previous one allowed to lapse into waste. This system is obviously very unfavourable to tree growth. Each village has an area of about 20—30 square miles of forests. The tribes stick tenaciously to their village site, but their cultivated area is, of course, shifted annually.

The writer expresses his best thanks to Mr. O. C. Ollenbach for the photos of Nagas and shrines at Dimapur. The other photos were taken by Mr. Sharma, photographer to this Institute.

S. N. CHATTERJEE,

Lower Grade Assistant to the Forest Entomologist, Dehra Dun.

REVIEWS.

FOREST FINANCE.

BY H. H. CHAPMAN. M.F., HARRIMAN PROFESSOR OF FOREST MANAGEMENT, YALE UNIVERSITY-PUBLISHED BY THE TUTTLE MOREHOUSE & TAYLOR COMPANY, NEW HAVEN CONN., 1926.

As stated by the author in his preface this text supersedes Forest Valuation published by him in 1914. Although the same

general treatment has been retained the contents have been entirely rewritten and considerably enlarged. Forest Valuation was intended primarily for use as a text book so it must be assumed that this is the main intention of this book also, although in the conclusion of his preface the author states that he hopes that the private owners of forest lands in America may be encouraged thereby to take up forestry as a private business enterprise.

The first eight chapters, 94 pages, practically one-third of the book, deal with general economic principles. This appears to be of doubtful utility in a work of this nature, and furnishes the chief grounds for criticism of this work as it did for his previous one. The chief interest in these chapters lies in his treatment of the subject of interest and especially of compound interest.

The true nature of interest is gone into very carefully. This is shown diagrammatically by figure II on page 18, which figure the author states should make this question clear. A study of the diagram, however, makes one conclude that he has been unduly optimistic. In para. 24 he states "when its character (interest) on capital is fully realized there will be less likelihood of the continuance of arguments citing the accumulation of compound interest to enormous totals as a reason for not undertaking the growing of timber." Throughout the book he attacks the bugbear of compound interest with great vigour and no little skill. He shows that compound interest requires complete abstinence, and the results that would occur were even a small percentage of capitalists to practise such abstinence and continually seek to procure 6 per cent. compound interest on loans; namely the increase in the supply of capital seeking interest at the expense of the residual capital engaged in production, with a consequent fall in the rate of interest. Again he states that "to claim that an investor must earn 6 per cent. compound interest for a period of 100 years is equivalent to admitting that this investor is not interested in any enterprise requiring 100 years for its completion and hence demands the astounding returns of $339·31 for every dollar he invests now in such an enterprise." Now this is all very sound indeed but will it encourage the individual investor and the

private owner of forest land? In more than one place in the book he makes it clear that future forestry in America must be carried on in a large part by private capital, or not at all, and a very large part of the book is devoted to a very courageous attempt to encourage the private investor and private owner. Let us hope that he will succeed in so doing. The general impression that an Indian Forester will get is that the future of forest conservancy in America is not bright and rosy. This is borne out by his not infrequent references to land logged over, finally abandoned, and claimed by the State for unpaid taxes.

The chapters on forest valuation proper, that is cost values, expectation values and the like, need little comment except that the tone is inclined to be dogmatic and that other methods or formulæ are little discussed. What is given is, however, very lucidly explained. The chapters on appraisals of damages and stumpage values are very clear and the questions involved are carefully and thoroughly gone into. Most of this can, however, only be of academic interest to Indian Foresters and others accustomed to forests under conservative management. Indeed this may be said of practically the whole work.

The chapter on Taxation is very interesting. The author very clearly shows the unfair incidence of taxation on forest lands and how the private owner is discouraged from investing money in forest ventures other than those of logging pure and simple. In this connection reference may be made to an article in the April number of the Journal of Forestry (Washington). Comparing a Bond investment made to produce a certain sum in fifty years with a forest investment to produce an equal sum in the same period, the latter is taxed six and a half times as much as the former. Several proposals are made for improving the state of affairs and making the incidence of taxation on forest properties more equitable.

The book concludes with a collection of problems on forest produce, a new feature not included in the previous work.

The book is excellently got up, well bound and clearly printed on good paper. There is a good index and in the text frequent

references to previous and ensuing paragraphs are made where necessary. The author unfortunately does not share the prevalent distaste for split infinitives. Practically every infinite in the work is so maltreated. (Only one misprint was discovered in the whole book.)

EXTRACTS.

REGULATIONS FOR THE APPOINTMENT IN INDIA OF PROBATIONERS FOR THE INDIAN FOREST SERVICE IN 1926.

A competitive examination to select two candidates for training for the Indian Forest Service will be held at Allahabad in the month of August 1926.

2. ....

3. All applications must be accompanied by the following certificates :—

(*a*) A certificate of age (see paragraph 4 below).

(*b*) A certificate that the candidate is a 'native of India' within the meaning assigned to these words by section 6 of 33 Vict., Cap. 3.

(*c*) Two certificates of recent date signed by individuals of standing which must state that the candidate is of good moral character.

(*d*) A certificate that the candidate has obtained an Honour's degree or the degree of M.A. or M.Sc. of a University approved by the Governor-General in Council or the senior diploma of the Mayo College, Ajmer.

(*e*) A preliminary medical certificate of fitness for service in the Forest Department signed by a Presidency Surgeon or the Civil Surgeon of the district in which the applicant resides, or a residency or agency Surgeon. This certificate is intended to prevent applications from candidates who are obviously physically unsuited for the Forest Service and will not exempt candidates from appearance before the final Medical Board.

4. All candidates must have attained the age of 19 years and must not have attained the age of 23 years on the 1st April 1926.

5. A candidate will be required to pay a fee of Rs. 5 with his application and a candidate chosen for admission to the written examination will be required to pay a further fee of Rs. 50.

6. All candidates will be required to appear before a Board for a personal interview for which 1,000 marks will be allotted. No candidate who fails to obtain 600 marks at this interview will be allowed to sit for the written examination. The marks so allotted will count in the total of the written examination.

7. All candidates who are selected as described in paragraph 6 will be required to undergo a physical test consisting of a walk of about 15 miles to be completed within a given time.

8. After the physical test all candidates will be required to undergo examination by a Medical Board.

9. Candidates who have successfully passed the tests described in paragraphs 6, 7 and 8 will be permitted to sit for the written examination.

10. The examination will include the following subjects. Each subject will carry the number of marks shown against it :—

SECTION A.—*Compulsory.*

(1) English Essay	1,000
(2) Ordinary everyday knowledge	1,000
(3) Mathematics	1,000
(4) One of the following—	
Botany	1,000
Chemistry	1,000
Geology and Physiography	1,000

Every candidate must obtain at least 60 per cent. in each of the compulsory subjects :—

SECTION B.—*Optional.*

(Any two subjects may be taken.)

Botany	1,000*
Chemistry	1,000*
Geology and Physiography	1,000*
Zoology	1,000
Higher Mathematics	1,000
Physics	1,000

NOTE.—In each of the above subjects 50 marks will be allotted for handwriting.

* Provided they have not been taken as a compulsory subject.

11. Candidates will not be paid any travelling allowance. No allowance for board and lodging will be made and candidates must make their own arrangements in this respect.

12. The candidates selected for training for the I. F. S. on the results of this test will be required to proceed to the Forest College at Dehra Dun for the course of training commencing on 1st November 1926 which will extend over a period of two years and which must be undergone satisfactorily before appointment to the Indian Forest Service.

13. Selected candidates while under training will be entitled to receive payment of all their fees at the Forest College and travelling allowances in connection with their training subject to a maximum of Rs. 450 a year in addition to a stipend which will normally not exceed Rs. 150 a month. The grant of these allowances will be subject to the following conditions :—

(*a*) that the progress of the probationer in his studies is satisfactory ;

(*b*) that the probationer gives security to refund the payments in the event of his failing to qualify for an appointment in the Indian Forest Service, or not signing the articles of agreement as specified in paragraph 16 or failing to join the Indian Forest Service at the end of the period of probation ;

(*c*) that the probationer undertakes to refund in proportions fixed under the terms of his agreement the amounts received in the event of his leaving the Service during the first 5 years from the date of his appointment.

14. *Conduct.*—Every probationer is required to conduct himself during the period of probation in a manner satisfactory to the Governor-General in Council and to give evidence of satisfactory progress in his studies in such a manner as may be required, failing which, or in the event of serious misconduct, he is liable to have his name removed from the list of probationers.

15. *Appointment and seniority.*—Probationers who comply with the requirements of paragraph 12 within the sanctioned period of time, and also satisfy such other tests as may be pres

cribed, are appointed Assistant Conservators in the Indian Forest Department, provided they are of sound constitution and free from physical defects which would render them unsuitable for employment in the Indian Forest Service. No probationer will be confirmed as a member of the Indian Forest Service who fails to profit by the course of training or who appears, in the light of the experience acquired as to his capacity and qualifications during the probationary period, to be unsuited for the work of a forest officer.

The position of the Assistant Conservators in the Provincial Forest Lists will be determined in accordance with the results of the periodical and final examinations held during the course of training at Dehra Dun. Assistant Conservators will take rank in the general seniority list according to the date of their confirmation in the Indian Forest Service.

Probationers are allowed at the end of the period of probation to state their preference in respect to the province to which they desire to be allotted ; but the distribution is made to the several provinces according to the needs of the public service, at the discretion of the Governor-General in Council and no guarantee can be given that probationers will, on appointment, be posted to their own provinces.

Officers are at all times liable to be transferred from one province to another at the pleasure of the Government of India.

16. *Articles of agreement.*—A probationer is required on qualifying for appointment as Assistant Conservator, to sign articles of agreement setting forth the terms and conditions of his appointment.

17. The scale of pay and allowances in force for officers of Indian domicile is given in Appendix II to these regulations.

18. *Promotion and pension.*—Promotion and pension are governed by the regulations laid down by the Secretary of State for India in Council, and applicable to forest officers, such regulations being subject to any modifications or alterations which may be made in them from time to time by him and their interpretation in case of any doubt arising being left to that authority.

Certain information regarding appointments in the upper controlling staff of the Indian Forest Service will be found in Appendix II and a summary of information regarding pensions, is contained in Appendix III.

[*The Appendices have been omitted.* It may be mentioned that twenty-six candidates appeared before the Selection Board at Allahabad in August 1926 and twelve of them were selected to sit for the written examination.—HON. ED.]

INDIAN FOREST SERVICE COMPETITIVE EXAMINATION AT ALLAHABAD

Allahabad, 19th August 1926.

Twenty-six candidates for appointment to the Indian Forest Service presented themselves for preliminary selection yesterday morning at the Senate House, Allahabad, before a Committee composed of Mr. A. Rodger, officiating Inspector-General of Forests, Mr. J. A. Richey, Educational Commissioner, Government of India, and Dr. Ziauddin Ahmad. As a result of the interview 13 candidates were selected. These 13 candidates had to pass a physical test this morning. All the 13 candidates started from Mayo Hall at 6 A.M. to-day. They were required to proceed $7\frac{1}{2}$ miles along the Cawnpore road and then to return. Mr. C. T. Trigg, an Instructor of the Forest College, Dehra Dun, accompanied the candidates to set the pace. The candidate who arrived at the starting point within one-quarter of an hour after the arrival back of Mr. Trigg were to be considered fit. Mr. Trigg walked at the rate of $4\frac{1}{2}$ miles per hour. All the candidates stood the test successfully. They returned a little after quarter past nine. Mr. Rodger also walked some distance to watch the candidates.

All the 13 candidates will be examined by a Medical Board to-morrow and if declared fit they will be required to sit at the competitive examination which will begin from the 23rd August and will conclude on the 1st September. Finally two candidates

will be selected for appointment in India as probationers in the Indian Forest Service.

The following is the list of the thirteen candidates who have been approved for admission to the competitive examination subject to their being declared medically fit :—

Chintamani Dedodapkar (Central India), Karan Singh (Punjab), Pyare Lal (Punjab), Dev Raj Mehra (Punjab), Saiyed Shujaat Ali Hasmi (Punjab), Shabbir Ahmad (Punjab), Uma Shanker (United Provinces), Mehi Pal Gupta (United Provinces), Chaudhri Alamgir Khan (United Provinces), J. Banerji (Assam), Krishnaswamy (Madras), Ramamurti (Madras) and Mahomed Majibullah Khan (Madras).—[*The Pioneer.*]

BRITISH WORK IN INDIA.

THE PRINCE'S TRIBUTE.

The Indian Civil Service Dinner Club held its annual dinner at the Hotel Cecil last night, when for the first time in its history a member of the Royal Family was present. The Prince of Wales proposed the toast of the Indian Civil Service, paid warm tribute to its achievements, and said young men contemplating a career therein could be assured still of a life of opportunity and responsibility and one full of interest.

Sir Michael O'Dwyer was in the chair, and proposed the health of the Prince of Wales. He said the Indian Civil Service stood for the ideal expressed in the Prince of Wales' historic motto, "I serve"—the spirit which had led their guest year after year to travel tens of thousands of miles to the remotest regions where the British flag was flying, thereby helping them to realize their common ideals and interests and stimulating their devotion to and enthusiasm for the Empire. In that same spirit the Prince covered the whole of the Indian Empire four years ago and saw every side of Indian life. He saw not only the pomp and pageantry of India, but also its problems. He was, therefore, in a position to appreciate the work and difficulties of the various services. The people of India, still sharply divided by racial, social and religious antagonisms, were realizing more and more that British rule was the rule that divided

them least, and that their only chance of ever attaining anything like national unity lay in the maintenance of a strong impartial authority to keep order, foster progress and ensure equal opportunity to all.

THE PRINCE'S SPEECH.

The Prince of Wales, who was enthusiastically received, said that the task of proposing the toast of the Indian Civil Service would be more suitably undertaken by Lord Reading, who had so recently returned to this country from five years of the closest association with its officers and could speak with certain knowledge of the results achieved during that time. He had spent only four very crowded months in India; but he was very glad to be at their dinner for several reasons.

First of all (he continued) because, in common with the people of his country, I have always felt a deep pride and interest in your great service; secondly, because you have been passing through a period of great difficulties and anxieties; and, thirdly (and much more important for me), I had some opportunity of seeing something of you and your work while I was in India. I am very glad to say that my tour was not entirely restricted to the great centres. Luckily for me, I had opportunities of getting into the districts, though they were not so often and so many as I could have wished. Much of the great work of your service is done upcountry, where the district officer is the only burra sahib that the ordinary people know, and where the Indian Civil Servant lives his fullest and truest life. These places are very often a long way from the routine of Whitehall or of Delhi—places where there is always a great deal of work to be done, where there is a great load of responsibility to be borne and many problems to be solved on the spot, far more by the exercise of personality than by regulation. (Cheers.) The situation is one demanding aptitude for administration.

A HEAVY BURDEN.

I have mentioned that you have passed through an anxious and difficult period, from which you are now possibly emerging. There have been many causes for this, and the one I wish to

speak upon is the financial cause. Owing to the great upheavals in the standards of prices caused by the Great War, the family budget of every Britisher serving in India was very heavily complicated. I am hoping that the acceptance of the recommendations of the Lee Commission will have done something to lessen these hardships over and above the usual worries of those who live in India. I look on the labourer in that field as one most worthy of his hire. (Cheers.) It would certainly be very unfair if private worries were to be added to a very heavy burden of responsibilities.

I am not only thinking of what the Accountant-General calls your emoluments; I am thinking more of the time mentioned by your chairman when possibly the I. C. S. seemed to be losing its buoyancy a little. It was not so much that the members had lost faith in their careers, but whether the people at home had ceased to believe in them. Before the war Great Britain and Ireland had given of their very best to the I. C. S.; there were many families which for generation after generation had sent their sons to India, knowing that India was "a good show." (Cheers.) Then after the war there came a slump. Depression came everywhere—not only in India, but also in England. The call of India, seemed out of tune, and even the I. C. S., as well as the other services, was starved for want of recruits.

"STILL A GOOD SHOW."

Though it is four years since I was in India, I have not lost touch with your Service. I have friends who always come to see me when they are home on leave, and from what they tell me I know that we are getting through that dark chapter. We all of us suffered from pessimism a few years ago. I think we rather overdid it then; and I do not think it is justifiable now. The high traditions of the I. C. S. and the other Indian Services did not spring from other sources—they were established by yourselves. I think all of you—the Civil Service, the Police, the Forestry, the Medical Services—can do a great deal to convince the younger generation that India is still "a good show." India still provides a field for British character and enterprise to be applied

and this makes up for many drawbacks of climate and other things that could be mentioned. India provides opportunity for a life of responsibility and a life full of interest. (Cheers.)—[*The Times.*]

SUCCESSFUL TRAINING IN EUROPE OF PANDIT PADMA DATT RATURI.

We are glad to learn that Pt. Padma Datt Raturi, M.Sc., an ex-student of the Provincial Forest Service class, Imperial Forest College, Dehra Dun, passed the Diploma Examination (Research Studies in Forestry) of the Cambridge University with distinction, topping the list of the successful candidates. We congratulate Mr. Raturi on his brilliant success. Forestmeister Dr. Heske, who has had considerable experience of forestry students as 'Privatdozent' at the Forestry School at Vienna, and who has recently been appointed by Professor Troup to arrange and direct the continental forestry tours of the students of the Imperial Forestry Institute, University of Oxford, writes, in the course of a letter to Mr. A. M. Caccia, M.A., C.B., late Director of Forest Studies, India Office, "Mr. Raturi prepared a complete working plan of a small forest in the neighbourhood of Frauenberg. Besides this I worked with him a thesis on the theory of the regulation of the yield, and the application of the different methods. As a result I feel compelled to confess to you that Mr. Raturi is the most intelligent Indian student whom I have seen up till now. He gained an unusual knowledge of forest management, particularly in regard to the regulation of the yield. It gave me great pleasure to direct the studies of this most able young man. Besides he proved himself to be a good hearted young man and a gentleman." Mr. Raturi is on his way home and is expected to land in Bombay on the 18th July. We wish him a prosperous career.—[*Dehra Chronicle.*]

CYPRUS TO-DAY—FARMERS AND FORESTS.

If the farmer in Cyprus under the Turks was periodically flayed by locusts he was constantly preyed upon by money-lenders,

and even now an experienced observer is of the opinion that the average Cypriot agriculturist would feel strange if he were not in debt. Indeed, the money-lender does all he can to prevent the poor fellow from experiencing that sensation and is generally supposed, in his other capacity as a dealer in corn and produce, to regulate prices in such a way as to remove any danger of running out of debt from the financial path of the peasant.

With the victory over the locusts as a precedent, the Director of Agriculture, then Mr. Bevan, about a dozen years ago devised a system of co-operative societies to help the farmer, and last year an agricultural bank was started, under the joint patronage of the Government and the Imperial Ottoman Bank to help these societies to extend their scope. They are not yet big enough to save all the farmers from the money-lenders, but they advance money at reasonable rates, and the co-operative sales have resulted in a distinct improvement in the prices paid compared with those obtained by individual farmers. In spite of the energy of Mr. Zarifi, the Registrar of the Co-operative Societies, their progress is only gradual, and their friends hardly expect them to release the whole of the peasant cultivators from the grip of the usurer for at least a generation. Still, a favourable start has been made, and the membership of the societies has increased by 150 per cent. during the last 12 months.

If, however, the progress of the co-operative movement towards the complete release of the Cypriot peasant from the burden of usury is likely to be slow, it has at least already achieved a marked improvement in his agricultural methods. For instance the farmer is beginning to buy better implements, to extend the scope and variety of his cultivation, and is so persuaded of the virtues of chemical manure that the import of this commodity has risen from 1.000 tons in 1921 to more than 9,000 tons, while measures are being taken to improve the quality and increase the production of his potatoes, his cattle, his barley, his cotton, his carobs, his oranges, his wine, his silk, and his newly revived output of flax. It may fairly be said that within a few years the farmer in Cyprus will be almost as progressive as he is

important in the economy of the island, and the Government is giving him a great leg-up this year by its decision to abolish the irritating and cumbrous tithe which yielded a widely fluctuating revenue, and to substitute for it a readjustment of the excise, for human thirst is considered to be a more constant factor than the fertility of the soil and the favour of the weather upon which the tithe returns so greatly depended.

THE WATER-SUPPLY.

The abolition of the tithe, which was a tax paid in kind to the Government and had nothing ecclesiastical about it, is a great relief to agriculture, as, with the best will in the world, its method of collection could not fail to be tedious and inconvenient, and it is welcomed as a first class reform. But the Government is not content with legislation and the readjustment of financial burdens. It helps the farmer by furnishing instruction and advice in the exercise of his craft, it helps him to improve his stock by providing sires of high quality at Athalassa Chiflik, the official experimental farm, and sends selected beasts in eyre through the island, and after a good deal of bad luck in the matter, is now again turning its attention to devising a really workable system of irrigation.

This is particularly difficult in Cyprus, as there are no lakes or perennial rivers to tap and, apart from a few really powerful springs—such as that at Kythræa, which is fabled like Arethusa of old to arise, if not from a "couch on the snows on the Acroceraunian mountains," at least in those of Karamania in Anatolia and to pass under the sea to emerge in a grateful Cyprus—the water-supply has to be mostly created before it can be induced to flow through irrigation canals. The Government hopes to find some of the necessary water underground and this year is prepared to spend at least £5,000 in experimental boring. This is a minimum, and as much money as is necessary will be provided for this purpose. But its chief reliance is on water from above, and it is to the Forest Department that the Cypriots look for help in the matter, and that naturally brings us to a

consideration of the splendid forests of the island as well as the beneficent activities of the Department which takes care of them.

The Forests in History.

These forests, famous for centuries, provided timber for Palestine in Biblical times, were used for the building of his fleets by Alexander the Great, and were so valuable a resource of admiralty that Ptolemy I. Soter, the first of the Macedonian Lagidæ to reign as Pharaoh in Egypt, conquered the island expressly to possess them—as he aspired to sea-power, just as Sultan Selim the Sot sent the unspeakable Mustapha to seize Cyprus some 19 centuries later because he wanted to drink its wine. The smelting of iron ore in Sussex is generally supposed to have broken the pride of the once mighty Forest of Anderida, in the same way the smelting of copper ore in Cyprus, begun under the Phœnicians and continued down to the time of the Romans, led to the denudation of large areas. Much still remained, and more than 1,000 years later King Richard found the island clothed with forest, the Lusignans were able to cut freely to provide timber for their splendid buildings, and as late as their last decade in the island, 1560—1570 the Venetians are said to have relied largely on Cyprus to supply the material for their galleys. Indeed, it is curious that, although their island produced the copper, the timber, the flax, and the hemp required for old-time shipping, the Cypriots were never celebrated as a seafaring race, or even as fishermen, and their maritime riches were generally exploited for the benefit of foreign conquerors, for even the Lusignans, under whom the island so long enjoyed independence and prosperity, were an outland dynasty supported by a dominant class of foreign origin, constantly recruited from abroad.

After the arrival of the British it was some time before the surviving forests, which had suffered much from neglect and from the wasteful methods of the peasants in clearing hill-land and cropping it until the rain had washed most of it away, and then repeating the process, were able to receive proper attention. In the first year for which the official expenditure on the forests is on record, 1880-81, only £156 was spent, and in 1884-85 the

revenue was £1,134, and it was not until the early nineties that the laborious work of restoring the forests was properly taken in hand, for it was by then beginning to be realised that the forests alone could be relied upon to prevent the winter rains from being wasted. The rainfall is small—about 22 inches per annum is the average for the whole island—and it nearly all occurs in a comparatively short time. The Cypriot for centuries has seen the water which he so urgently needs for summer use rush destructively down the mountain watercourses, hurry past his farm, perhaps tearing away a slice of his best land or depositing unwanted shingle and rubbish in its useless passage, in order to lose itself in the Famagusta marshes or in the sea.

Where the forests survive, or have been restored, much of the rainfall gets a chance of soaking in, to reappear in the springs later in the year, and now the Department has begun to terrace the hills across rain-scored clearings or on barren slopes in such a way that the terraces slope gently inward towards the mountain, and thus, when planted, retain the rainfall which, before the terraces were made, would have run destructively to waste without more ado.

This naturally is an expensive process, costing about £30 an acre, but it acts as a most efficient check on further local erosion and saves good land on lower levels from being overwhelmed under spate-born spoil and detritus. In this way it is hoped that the restored forests will gradually form a natural reservoir for the retention of the mountain rains, which are much heavier than in the plains—one hill-station registered 61 inches in 1925—and preserve the water for summer distribution, for experience has shown that ordinary dams are of little use on these torrents as they so soon get filled with silt. So long-sighted a policy naturally requires a good deal of time to mature, although in Cyprus trees grow with satisfactory rapidity, and meanwhile the Department is busy with work of immediate and every-day utility. From special plantations of quickly growing trees as well as from forest growths which have reached their prime it supplies firewood for the whole Island at the rate of 38*s.* a ton cut and delivered to the door; and through its own store it sells timber for building at reasonable

prices ; it provides wild-olive seedlings for free distribution and subsequent cultivation and grafting ; takes charge, when asked to do so, of privately owned woodlands ; and co-operates with various public authorities in planting trees for ornament, for firewood or other forms of utility outside the forest areas, with a most beneficial effect upon the health, amenity, and appearance of the Island. Since the Department began to function it has spent over £684,000 in rehabilitating a wasting asset, and has drawn just under £600,000 in revenue from its forests which have at a net cost of about £85,000, been increased tenfold in actual timber value, from an estimated £200,000 to at least £2,000,000.—[*The Times.*]

FORESTRY BILL PASSES SECOND READING.

In the House of Lords, on Tuesday, Lord Lovat (Chairman of the Forestry Commission) moved the second reading of the Forestry Bill, which, he explained, would increase the number of Commissioners of the Forestry Commission from eight to ten, an increase rendered necessary by the growth of the Commission's work. The Bill also empowered the Commission to make by-laws to safeguard wooded areas in their earlier stages, and when they had got to a stage when the public could enter and use them. Certain of these areas, such as the New Forest and the Forest of Dean, were much used by the public, and it was important to have by-laws to keep down some of the abuses which had arisen.

Earl De la Warr gave notice that on the Committee stage he would move an amendment to bring the Forestry Commission under the control of Parliament. It was not desired that they should be subject to interference in details, and no one doubted the efficiency with which they carried out their work, but it was reasonable that Parliament should control the spending of public money.

The Bill was read a second time.—[*The Timber Trades Journal.*]

TRAINING IN FORESTRY.

ANNUAL MEETING OF "THE MEN OF THE TREES."

The first annual general meeting of the society known as "The Men of the Trees" was held yesterday afternoon at Thripands, 48, Kensington-court, when the first annual report was presented.

Colonel R. E. Crompton presided, and explained the object of the association, which is to stimulate interest in tree growth in this and other countries. The movement was first started among African tribesmen in the highlands of Kenya in 1922, by Mr. R. St. Barbe Baker, Assistant Conservator of Forests and met with great success. The members promised to plant ten trees a year and to take care of trees everywhere. As it was thought that the same idea might advantageously be employed by other countries, an association of "The Men of the Trees" has come into being in London for the purpose of linking together all who wish to help in this work.

The Hon. Mrs. Grant Duff, honorary secretary of the association, detailed the work of the past year, and insisted upon the attractiveness of the movement for the young.—[*The Times.*]

THE TRAINING OF ELEPHANTS.

A very full account of the training establishment at Api (Belgian Congo) is to be found in Mr. T. A. Barnes' book "Across the Great Craterland." The details are intensely interesting. Elephants appear to be successfully used for farm work at some of the neighbouring mission stations, but such an authority as Mr. Percival, with 22 years' experience in the Kenya Game Department, gives his opinion (in "A Game Ranger's Notebook") that unless the timber industry in Africa were much more developed, the training of elephants would not be worth while. A working elephant, he says, must waste a large proportion of its time in feeding; and in most districts it would be difficult to provide the necessary amount of green fodder

Mr. Barnes mentions the interesting fact that at Api seven-year-old elephants do full draught work, while an Indian elephant only starts full work at 15.—Mr. A. L. N. Russell, Rugby House, 292, Lancaster-road, W. 11.—[*The Times.*]

KEROSENE AS A FUEL.

The possibility of employing Kerosene (Paraffin) in what is practically an ordinary petrol engine is a matter which is just now receiving considerable attention. It is particularly important in relation to tropical and sub-tropical countries, in many of which this heavier type of fuel is often available in adequate quantities and at moderate cost, whereas petrol is comparatively expensive and sometimes unobtainable. Many commercial motor vehicles exported from Great Britain through the medium of the Crown Agents for the Colonies have been running well on kerosene for several years past, but the use of this fuel by ordinary commercial concerns might advantageously be much extended. Its successful employment, however, depends on the use of a good type of vapouriser in conjunction with the carburetter and proper attention to the question of lubrication. A make of vehicle which has done particularly well when using kerosene in many different countries is the Albion. Either the 24 h. p. or the 32 h. p. engine of this make can be fitted for kerosene. The general principle is that the mixture is drawn through a special exhaust heated chamber. Moveover, the lubrication system is particularly suitable for use in heavy oil engines because under the Albion-Murray system each bearing and each cylinder receives a small supply of entirely fresh and uncontaminated oil for so many revolutions of the crankshaft. The mileage per gallon is just about the same as when petrol is employed and particularly in fairly hot climates, there is no reason whatever why kerosene should not be more extensively used than it is.

A good example of its successful employment has recently reached me from lower Burma and refers to a motor boat fitted with an Ailsa Craig "kid" 10/14 h. p. four-cylinder engine. The boat is used by the Manager of a development syndicate and has

averaged sixty miles a day during the past year, which is an extraordinarily high record for any motor boat. Kerosene has been used throughout and, despite the fact that it tends to leave a far heavier carbon deposit than petrol, the efficiency of the Ailsa Craig vapouriser has been such that the engine has not yet required to be decarbonised and has given no trouble whatever up to date.—[*Capital.*]

GIANT CEDARS.

Writing recently to the *Times*, Lord Ullswater, of Campsea Aske, Wickham Market, Suffolk, says :—

I have just measured the cedars on my lawn and have taken the measurements at 5 feet from the ground. They measure respectively 21 ft., 20 ft., 19 ft. 19 ft., 18 ft. 5 in. and 17 ft. There are no side branches or remains of side branches included in this measurement. Mr. Bean, of Kew, informed me that they were the finest he had seen in England. This was in 1924.

In a subsequent issue the following letter appeared :—

After reading Lord Ullswater's letter in the *Times* of April 5th, I was induced to measure some of my cedar trees here. Measured 5 ft. from the ground they give the following figures : 29 ft., 24 ft. 2 in., 22 ft. 4 in., 19 ft. 11 in., 19 ft. 3 in. and 18 ft. 5 in. All these cedars are supposed to have been planted by the Hon. Charles Hamilton about 1740, and Mr. Elwes in his last book gives the big cedar here as being the largest in the British Isles, when he measured it in 1904.—Ethel Combe, Pain's Hill, Cobham, Surrey. —[*Timber News.*]

INDIA TEAK EXPORTS.

Extract from article " Present and Future Timber Supplies.—Possibilities of Empire Products," by Frank Tiffany, in the " Timber News," dated the 24th April 1926 :—

India Teak Exports.—His (Mr. Howard's) comparisons as to the ratio of our taking the Indian timber as against that of other countries need some further explanation. The figures of £750,000, of which £707,157 represent teak alone, speak louder

than words, and we arrive at the fact that the total value of Indian woods imported, exclusive of teak, is a mere bagatelle of under £43,000—for the whole of the United Kingdom hardly the turn of a retail yard. In the face of this there can be little wonder that about a year ago the Indian Government appointed a committee to "investigate the methods of marketing timber."

Whilst recognising that Indian forest personnel has to meet the requirements of a teeming home population, it would have been thought the export trade should show a better position, especially after the able propaganda of recent years. The exhibits at Wembley prove beyond doubt that these timbers are of exceptional beauty. If it were possible to place teak on the market at more reasonable prices it would be assured of an increased demand.

Teak possesses characteristics which are peculiarly its own, and for certain work it is without compeer, yet its ever-advancing price restricts the demand, and when it is realised that the total value of all other Indian woods is but £43,000 per annum, whilst according to Mr. Howard in 1919 we paid £2,000,000 for American oak alone, it is apparent that there must be something seriously wrong in the Indian methods. It is to be feared that the problem will not be solved by Mr. Howard's aphorism: "We have in a fit of absence of mind forgotten the immense advantage of paying our own money for our Empire timbers, and the terrible danger of paying our money to foreigners for theirs."

Use of Foreign Timber.—If there be, to use Mr. Howard's own words, "a prejudice in favour of foreign timber" there must be some underlying reason therefor, so that it is only proper in our Imperial interests to get at the bedrock of fact. The position is indeed most grave if the statement made by Mr. Howard be true in fact and substance:—"The leading railway companies, who previously used considerable quantities of hardwoods which could be obtained from within the Empire, have, since the war, changed their specifications, and demand German, Russian or Polish oak, American mahogany and American black walnut. The sawing which might be paid to our labourers is paid to Americans."

The last paragraph indicates the tendency to import "sawn lumber" in place of logs. This in itself raises a very serious question, and may in part explain the increase of unemployment, and it would be well if our Labour leaders would consider the best means to retain their own industries.

Reverting to Mr. Howard's experience with the railway companies, he states :—"He who makes any attempt to persuade these authorities to change, while meeting with enthusiastic remarks in favour of using Empire timber instead of foreign, finds every possible obstacle placed in his way." If the propagandist fails in his appeal, it does not afford evidence that the experts are at fault, fools or fossils. It is a buyer's privilege to decline purchase of any given commodity without assigning reasons, yet as a matter of public interest it would be a guidance to the Indian Government if it were possible for them to have reasons for the change of front on the part of the railway companies, alleged by Mr. Howard.

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TIGERS IN BURMA

BY S. F. HOPWOOD, I.F.S.

Burma is without fame as a tiger-shooting country. No Princes, Viceroys, Millionaires, nor Army Officers ever visit its shores with the object of shooting tigers. The conditions under which the sport is followed are very difficult and the chances of success are remote compared with Nepal or the Central Provinces. One seldom hears of tigers being shot in Burma and it will come as a surprise to most people to learn that nearly as many tigers are killed each year in Burma as in all the rest of India. In his book "Wild Animals in Central India." Mr. A. A. Dunbar Brander speaking of the Central Provinces states—"Few tigers are killed by native shikaris. These chiefly shoot deer. It is the European sportsman that thins out the tiger." Herein lies the principal difference between India and Burma. In Burma few tigers are killed by the European sportsman but they are killed in large numbers by the Burman *mokso* or hunter.

In Burma, game rules have been in force for many years prohibiting the killing of immature animals and females of certain species and either laying down a close season during which males may not be shot or else limiting the number of males which may be shot annually by each person. Except that in common with all other animals tigers may not be hunted in a reserved forest except under the provisions of a license which costs Rs. 10 per year, not only are there no provisions in these game laws giving any measure of protection to tigers, but these animals are

regarded as vermin and rewards are paid by the Government for their destruction. Certain Deputy Commissioners even issue poison to the headmen for the destruction of tigers. Although very few persons are killed by tigers in Burma compared with India, it is in parts of India that tigers are accorded some measure of protection by the legislature; in one Province it is, I believe, forbidden to sit up at night over a kill for a tiger. The following is the scale of rewards:—

For a tiger, full grown............Rs. 40.

For a tiger cub.......... ....Rs. 20.

In addition Deputy Commissioners may offer a special reward up to Rs. 100 for the destruction of a man-eating tiger.

Each year the Government of India publish statistics showing the number of persons killed by wild animals in each Province and the number of wild animals destroyed together with the amounts of rewards paid for their destruction. Figures in the following table show the number of tigers killed in Burma, the rewards paid for their destruction and the number of gun licenses in force in each year:—

Number of tigers destroyed in Burma and amount of rewards paid for their destruction in each calendar year from 1903 to 1924, and number of licenses issued in Burma under I. A. A., 1878.

Year.	Number of Tigers destroyed.	Rewards paid for their destruction	Number of licenses issued in Burma under I. A. A., 1878.
		Rs.	
1903	311	11,192	905
1904	276	10,450	888
1905	293	10,890	850
1906	356	12 890	952
1907	344	12,710	1,034
1908	351	12,965	1,179
Carried over ..	1,931	71,097	...

Year.	Number of Tigers destroyed.	Rewards paid for their destruction.	Number of licenses issued in Burma under I. A. A., 1878.
		Rs.	
Brought forward ...	1,931	71,097	
1909	421	15,870	1,299
1910	475	16,930	1,523
1911	503	17,330	1,688
1912	511	19,110	3,610
1913	455	16,810	7,390
1914	506	18,850	7,661
1915	532	19,540	7,530
1916	536	19,250	7,675
1917	484	17,190	8,051
1918	519	19,580	7,926
1919	663	24,900	7,33
1920	652	23,790	11,062
1921	826	30,435	10,954
1922	766	28,925	11,348
1923	793	30,045	
1924	821	31,220	
Total ...	11,394	42,08,72	

Before discussing these figures the question of their accuracy must be considered. In the past there have been many instances of fraud in connection with the rewards paid for the destruction of wild animals. Cases have occured in which dishonest magistrates have paid rewards to themselves for the destruction of

non-existent animals and in certain districts the broad arrow punched on skins to indicate that the reward has been paid has been obliterated and the skins produced a second time for payment of the reward. The method of carrying out this swindle was as follows:—

Plugs were cut from another skin and were fitted into the holes punched in the skin and glued in. The inside of the skin was planed over and then smeared with ashes. It was very difficult to ascertain whether the skin had been punched before or not. This practice was very successful in at least one district of Burma in 1921 until several of the swindlers were convicted and sentenced to imprisonment. It is also probable that skins are brought over from Siam and produced for payment of reward. Rewards have also sometimes been paid on the skins of certain species of wild cats which have been passed off as immature tigers, but it may be taken that on the whole the figures show fairly correctly the number of animals killed each year; in fact, it is most probable that the number is an under-statement and that very many more tigers are killed than is shown. Many of these animals are killed by Burmans with shot guns loaded with buckshot. Sitting up at night over a "kill" with a muzzle-loading gun it very frequently happens that the *mokso* or hunter wounds the animal and it would not be too much to say that one animal in every four thus shot at and wounded manages to make its way into some thick patch of jungle to die. Many of these wounded animals are never found. The figures therefore as far as Burma is concerned may be taken as correct in so far as they show the number of animals on which rewards have been paid but it is probable that the number of animals actually killed is far greater than that shown in the statement. I do not know how far the figures published by the Government of India for the other Provinces of India show with any accuracy the number of tigers killed in these Provinces. For the purpose of this article I assume them to be correct.

The total number of tigers killed in India in 1923 was 1,686, of which Burma contributed 793, and in 1924, 821 were killed in

Burma out of 1,706 destroyed throughout the whole of India. For the year 1924 the figures for each Province were :—

Madras 70, Bombay 60, Bengal 59, United Provinces 102, Punjab nil, Burma 821, Bihar and Orissa 101, Central Provinces and Berar 307, Assam 175 and Coorg 11.

For the seven years 1918 to 1924 on the average two tigers a day have been killed in Burma.

The number of tigers killed in Burma shows a steady rise from 311 in 1903 to 821 in 1924. (The year in which most tigers were killed was 1921 when 826 were destroyed but 1924 very nearly approached this figure with 821.) This rise corresponds with the rise in the number of gun licenses in force. The number of gun licenses in force has risen from 905 in 1903 to 11,348 in 1922. Throughout India the year 1921 saw a great increase in the number of tigers killed; every Province except Bengal and the United Provinces showed an increase in this year. In Madras the figure rose from 70 in 1920 to 82 in 1921, in Bombay from 33 to 51, in Burma from 652 to 826, in Bihar and Orissa from 114 to 122, in the Central Provinces and Berar from 188 to 300 and in Assam from 461 to 619. Figures for Assam after 1921 show a very heavy decrease and in 1924 only 175 tigers were destroyed here, but Burma and the Central Provinces maintained their place with 821 and 307 in 1924. In Forestry it is the aim of even the least ambitious system of management that there shall be at any rate a " sustained yield." I do not think we can hope for a sustained yield of over 800 tigers in Burma and it is doubtful whether it is desirable that we should take steps to ensure a " sustained yield " of tigers.

Tigers are found in every district in Burma except purely urban districts such as Rangoon. Even the Myingyan district in the dry zone can usually boast of a tiger inhabiting the slopes of Mount Popa

The damage done by tigers is incalculable and the good they do is almost negligible.

The damage done by tigers may be divided into four classes according as they kill .—

1. Man.
2. Elephants.
3. Other domestic animals.
4. Wild animals.

Man.—It is interesting to compare the records of the casualties in each Province which have occurred in the ceaseless war which is waged between tigers and man. In Madras for the nine years 1916 to 1924, 4,336 men and 722 tigers were killed—an average of 6 men per tiger; in Bihar and Orissa 3,331 men were killed and 819 tigers—an average of 4·1 men per tiger; in the Central Province and Berar 1,702 men and 1,974 tigers—an average of ·89 man per tiger; in the United Provinces 363 men and 591 tigers —an average of ·61 man per tiger; in Bengal 465 men and 830 tigers—an average of ·56 man per tiger; in Assam 848 men and 3,013 tigers—an average of ·28 man per tiger; in Bombay 335 men and 820 tigers—an average of ·21 man per tiger, and in Burma 542 men and 6,060 tigers—an average of ·09 man per tiger. It will be seen that only in the Provinces of Madras and Bihar and Orissa does the victory lie with the tiger and the honours lie with Burma. If tigers had killed men in Burma on the same scale as in Madras during these nine years they would have killed 36,360 persons. I do not think that the tigers of Burma are less dangerous than those found in India; neither can it be said that they do not like eating Mongolian flesh.

Though the tigers of Burma differ very largely in their habits from the tigers of India, the heavy casualties suffered by man in some of the other provinces of India are due not to the fact that the tigers are different but that the inhabitants of the country are different. Directly a tiger takes to man-eating in Burma his days are numbered. The Burman has numerous traps for killing tigers, the commonest being a gun set so that if the tiger returns to the kill he is shot through the heart. If a gun or a crossbow is not available another simple trap is frequently resorted to. Round the "kill" there are set in the ground large

numbers of stakes sharpened and pointed upwards. A large bamboo is then split in half at the end and is so arranged that when the "kill" is touched the two halves of the bamboo spring together. The tiger touches the "kill" and releases the bamboo, the two halves of which come together with a loud report close to his ear. He springs high into the air and wherever he falls some of the sharp-pointed stakes go right through his body. Many tigers in Burma are killed by this simple trap.

This year in the Gangaw sub-division a tiger killed seven persons. A villager went to the Sub-Divisional Officer, Gangaw, borrowed a gun, tied up a cow outside the village, and shot the tiger over the cow. In the Seywachaung in the Lower Chindwin forest division in February 1926 a tiger killed a girl. Next day the village hunter killed the tiger and was himself killed by the tiger.

In 1922 on the Kodan stream in the Upper Chindwin district a tiger entered a house and killed all the inhabitants (three women and a two year old child) in a room of the house, except a small boy who crouched in a corner and passed unnoticed. Next day the villagers built a large box-trap and baited it with one of the dead bodies and caught the tiger that evening.

I have seen it stated that it is owing to the forests being much less dense and much more heavily populated and owing to the fact that there is less game to kill that tigers kill so many men in India. I do not think that this is the correct explanation. Burma is very badly provided with large mammals compared with India. There are no cheetal or swamp deer and pig are comparatively scarce in many districts. It is owing to the prompt action that the Burman takes whenever a tiger begins to kill men that so few persons are killed by tigers in Burma.

(To be continued.)

FIRE PROTECTION IN PLANTATIONS.

In his article published in the July number of the *Indian Forester* Mr. Shirley puts forward very sound arguments in favour of fire protection in plantations of teak and other species :

his plea in the case of pure teak is based on the evident fact that erosion of the soil takes place to an alarming extent when undergrowth is deficient, and that annual burning prevents the development of this undergrowth. This was first pointed out to me by Mr. J. D. Clifford in 1915, at a time when anti-protectionists were beginning to carry the day in Burma and the policy of protecting teak plantations was being given up in favour of early burning.

Since that time I have seen a good many teak plantations under the new conditions, and have gradually come to the same conclusion as Mr. Shirley, with this exception, that I am convinced that undergrowth has a better chance of serving its purpose as a counter-agent of erosion if the teak leaf fire has taken place early in the season, and perennial plants whose new growth normally begins well before the end of the dry season are not reduced by late fires to a state of ineffectiveness. Mr. Shirley I fear will not listen to a word in favour of early burning, but whatever may be the difficulty in carrying it out over large stretches of forest, it is a simple matter in teak plantations with their inflammable and uniform leaf-fall and limited area. My contention is that if this easy operation has been performed, the plantation is safe from a late fire, and that the undergrowth, perhaps not quite so luxuriant as under complete protection, remains adequate. If it can be proved that it is not adequate, and that the resulting erosion is really serious, then we are justified in spending money on complete protection (early burning costs nothing).

Fire protection was in the old days looked on as a necessity, and strong arguments were needed to justify its non-application. Surely in these days we agree that its benefits are at least questionable, and the matter to be decided is whether we are right in laying out money to accumulate interest for a long period, with so uncertain an object? What we have to justify is protection, not its opposite.

Mr. Shirley quotes an instance in which he has noticed erosion in a plantation said to have been early burnt. Had it

really been "early burnt"? Or was it on a steep slope which would be eroded in any circumstances? I have myself seen such a case in Zigôn division and venture to suggest that had Mr. Shirley seen it while still under protection his impression might have been the same as regards its erosion. Judging from the persistence undamaged of large teak on steep slopes in places where burning must have been early—near villages—he cannot I think justly impute the damage to early burning. Much clearer evidence is in my opinion necessary.

One of Mr. Shirley's arguments is that we ought to see that the conditions of natural forest are reproduced, and to save impoverishment of soil by encouraging undergrowth. He admits that the heavy canopy of a pure teak crop must check light demanding undergrowth to some extent even if fire protected, but he advocates the encouragement of non-fire-hardy shade bearers by protection. Is this reproducing the natural forest conditions? I think not. A teak plantation with an evergreen undergrowth looks very nice—I admit an enthusiasm for *Croton oblongifolius* myself—but such an undergrowth is not natural to teak forest and may possibly prove even harmful. Moreover the very notion of ensuring the persistence of natural conditions by introducing an unnatural factor seems to me as unsound as the theory uuder which our predecessors laboured when they insisted on fire protection in natural forests in order to preserve fine hardy species from extinction!

Mr. Shirley's article purports to refer to teak plantations. Yet he cannot refrain from having a 'dig' at what he calls 'rather an Irish system of fire portection,' *viz.* early burning, presumably in natural mixed forest. He states that he has failed to find any area in which this treatment has done anything but harm. Had he given instances to illustrate this extraordinary observation his subsequent arguments might be more convincing, but he has not. His instances refer to plantations alone.

He mentions 'natural fires' as occurring when fire hardy species are dormant. Queries—what is a 'natural fire'? and when are fire hardy species 'dormant'?

Mr. Shirley makes us picture our mixed forests as consisting of species which all 'hibernate' at once, for whose benefit Nature kindles a fire exactly at the right moment! Such an idyllic state of affairs must of course not be upset by the thoughtless Forest Officer!

Take fires first. They are of course in nature as irregular in their occurrence as anything can possibly be. Perhaps Mr. Shirley—if persuaded that all vegetation is not 'dormant' at once—will argue that Nature provides a fire to suit each tree's 'dormant' period! In 'nature' under modern conditions of population in forest tracts, a fire is of no account until it will spread. Its kindling depends, with minor exceptions, on man, and its spreading depends on the amount and distribution of inflammable material on the ground. This again depends on the leaf fall of the trees, whose distribution depends on soil and locality: climate again comes in with its various influences. The whole matter is so complicated that, in our Burma deciduous forests at least, no uniformity of time or place can possibly exist in these 'natural fires.'

Now for 'dormant' periods. In temperate climates some case can be made out for such a theory: plants may almost be said to hibernate in the sense that a squirrel does. Recent research proves that the body temperature of an hibernating squirrel is reduced 60° below normal: it may also show that plants under similar conditions evince a corresponding lowering of vital force. Mr. Shirley talks of rising sap—why should heat cause the bursting of vessels when sap is rising in them more than where it is stationary? He would hardly argue that his dormant plants are devoid of sap and so proof against damage, as they would then be surely more inflammable. Further, I venture to suggest that sap may not be presumed to 'rise' except when active growth is taking place, and such growth usually ceases before leaf fall permits of the earliest fire. Mr. Shirley's 'rising sap' argument seems to condemn late fires far more strongly than early fires, as fresh growth admittedly begins in the hot weather in most species concerned.

In our deciduous sub-tropical forests nearly every species has its own peculiar period of rest and growth. There is no

common rest period, as anybody who tours in the hot weather can see for himself. There is in fact not a day in the dry season on which certain trees are not busy growing fresh leaves or flowers, or on which seedlings cannot be found showing active growth. Even individual species show remarkable variation : in July this year I saw many healthy *Terminalia tomentosa* trees not yet showing a leaf in normal moist forest : their leaves are often out by May. *Pyinkado* (*Xylia dolabriformis*) may come into leaf any time from March to May. On the whole seedling and young growth liable to fire damage produce fresh growth earlier than older trees and are less irregular as to periods, but these very diverse, and give the lie direct to any theory of a uniform periods are nevertheless resting time.

In sub-tropical forest periods of rest and growth do not depend on temperature, as they do in higher latitudes. Nor do they depend altogether on moisture conditions—it is in fact impossible to say that they depend on any simple factor. Most of them are enabled to start re-growth on food material accumulated in their tissues underground, quite independently of any seasonal conditions of soil moisture at the time. Trees such as *Pentacme suavis* for instance, which grows in Burma from sea-level to well over 3,000 feet, will start re-growth in the driest time of year, but under very different temperature conditions : the actual stimulus is hard to imagine.

Other important trees, such as teak and *pyinkado*, almost equally fire hardy, become active at other times, and whatever date a fire occurs it is certain to find active growth to damage. Mr. Shirley's argument, as already hinted, serves to strengthen the position of the early burning policy, as it cannot be gainsaid that active growth in trees of any age increases in volume as the hot season advances, and that an early fire will find fewer cases of new growth to harm than a later one. Moreover, the actual damage done by late fires to young growth has no bearing on any question of dormant or active periods as such. What actually happens is that a fire, by burning back fresh green growth, even if not damaging well-protected stems of a year's standing, will

not only deprive vegetation of the actual growth made but will put it still further back by damaging its vegetative activity. In the case of a tree like *In* (*Dipterocarpus tuberculatus*) which adds most of its height increment before the monsoon sets in, such damage late in its growing season may result in virtual loss of a whole season's growth. *In* is rather an extreme case: other more valuable trees may be so affected in less degree.

Mr. Shirley admits that an early fire is less hot than a late one, but claims that it is slower and therefore more harmful. Apart from the fact that it finds more harm to do, I should like to show Mr. Shirley a typical late fire and let him contrast it with an early one. I think he would admit that the slowness of the early fire can bear little comparison in harmfulness with a roaring April conflagration fanned by a high wind, even if the latter moves at three times its speed!

I should, however, run the rink in so doing of involving Mr. Shirley in a doom very much hotter than the one he prescribes for the advocates of early burning, so perhaps I had better be charitable and let him spend the hot weather in Maymyo.

I will not conclude this without giving voice to a fear which is always strong in me when decrying fire protection. No man is infallible, least of all a Forest Officer. If, as I confidently believe, a really late fire may be a calamity,—and most people will admit this—we run a much greater risk of such a fire if we protect than if we burn early. Small areas are easier to supervise than large, but our forests are much more populous than they were, especially where heavy work is going on, and *taungya* regeneration areas increase the risk of late fires. However well a block is ringed by fire-lines, fires will start inside if introduced by wind or by man, and the harm is then done—a harm which may undo the good of years of successful protection. This to my mind is one of the chief arguments against protection, and cannot be countered by the plea of the efficiency of modern methods. They can never be wholly efficient.

C. G. E. DAWKINS, I.F.S.

THE INHERITANCE OF GROWTH FORM IN TREES.

This question continues to interest many investigators in various parts of the world, and papers on the subject continue to appear at intervals in the forestry periodicals. Of late a paper (1) published in 1924 by *Dr. L. Tschermak* from the Mariabrunn Experimental Station, entitled "The forms of larch in the Austrian Alps in relation to the locality," has renewed the controversy and called forth emphatic pronouncements from partisans of one view or another. Dr. Tschermak carried out a series of investigations in the larch both pure and in admixture with spruce in the Austrian Alps, and arrived at the conclusion that the frequently occurring sabre shaped boles are due simply to the conditions under which the affected trees have grown; it may be caused by a variety of external influences and there is no question of its being an inherited phenomenon. He adduces three lines of evidence for this decision.

(1) Even where conditions are optimum for larch at the centre of its distribution, crops are not predominantly straight stemmed.

(2) Straight boled crops can be found wherever they have not been unfavourably influenced by external factors such as snow, wind, partial suppression, trampling, etc., and are more frequent at lower elevations where all these factors are less likely to be in play.

(3) Cross sections of sabre shaped boles show concentric inner rings, then excentric rings with red pressure wood, and then again concentric rings without it, showing that the trees were erect at first and again finally, but went through a stage during which they were exposed to a bending force.

He also points out that larch with its sensitive leading shoot [compare deodar] would be expected to be much more affected by external factors than spruce, fir or pine. Seedling experiments were started but will take a good many years to yield conclusive results.

In 1925, Dr. Hartmann published a paper (2) under the title "On Sabre-growth of Trees" in which he recorded his experience with conifers in the lowlands. He found with seedlings that the direction of the basal part of the stem is affected to some extent by that of the root but is generally vertical even on steep slopes; also that bending occurs under heliotropic stimulus with sidelight, and in 12 year old larch by wind action. The many examples which could not be simply accounted for led him to conclude that trees vary in their "tendency to curved growth through heritable properties in the wood, through a heritable root, stem and crown form, and through a heritable crookedness of the leader." He points out that many workers have clearly shown the existence of inherited race characteristics, but none has yet proved conclusively inheritance of individual growth tendencies within a race, owing to the difficulty in pollination for raising pure strains. However he considers that the probabilities are all in favour of such inheritance, and concludes "The results of experiments made so far, and of examination of existing crops, make it very probable that in localities with less developed external factors directly causing crookedness in tree stems, internal heritable factors play a not inconsiderable part, which may increase with suitable selection." Dr. Tschermak rejoins (3) and not without reason, that the more important investigations of Engler, Cieslar, etc., have demonstrated the existence of local races, and that the failure of these to thrive when transported to new localities with different conditions, is due to inner inherited physiological peculiarities, whilst his own investigations are all on one indigenous race; further that the existence side by side of trees, some straight and some crooked through the action of wind, is no proof of differences in constitution, as wind conditions have been shown by Kraus (4) to vary greatly in quite small distances.

Then Dr. M. Schreiber (5) appends to a summary of the present writer's article (6) on "Twisted Fibre in Trees," a criticism of Tschermak's paper, disagreeing fundamentally with Tschermak's conclusion that inheritance has nothing to do with the sabre-shaped boles of larch. Dr. Schreiber's contention is similar to that of Hartmann, that such a conclusion is not justified by

the data presented, is contrary to the probabilities of the case, and could only be proved by large scale comparative cultural experiments such as were made with the twisted pine. Dengler, himself a worker in this field, reviews (7) Tschermak's paper almost without comment.

Whilst realising that Tschermak has collected a lot of useful data which other workers can utilise as they think fit we incline to agree with his critics that he is not justified in putting his deductions as dogmatically as he has. As was found in the study of twisted fibre, the facts presented by trees and crops are too often contradictory and inexplicable, and lend themselves to manipulation to support distinctly divergent views. That he himself feels that further proof is called for, is evidenced by his starting a series of sowings of seed from known parents (really one parent only!) which is a very laborious procedure. At the same time it may be admitted that he has made out a good *prima facie* case that in the race of larch indigenous to the locality in which he is working, curved stems are in the majority of cases traceable to definite external causes even if that race may, compared with other races, possess greater inherent tendency to develop the curved stem. It is to be hoped that the sowings have been made on a large enough scale and under a sufficient range of conditions to give conclusive results in time—useful information should be forthcoming in ten years at the latest.

Thus it would appear that Tschermak's researches have not advanced us much towards the solution of the problem of the inheritance of individual characteristics in trees, but should draw attention to another promising case for investigation. Incidentally, it is rather surprising that some of the indefatigable Continental workers have not tackled the problem—an important one in such investigations—of controlled pollination in forest trees, particularly conifers. In this connection also, an extract from a paper (8) by *Dr. Busse* of Tharandt on the "Influence of the age of the parent pine tree on the descendents," is *àpropos*. The experiments began in 1914 and his youngest class of parent tree was only 16 years old: the plots were all of the same size and the each age class was tried in 4 plots. The offspring of the

16 year old parents have an average of 19 trees per plot already carrying cones, as compared with 5 or 6 for those of the 75—112 year old parents and one only for the oldest class of 140 years and more. It certainly looks as though the early fertility had been inherited. Although not concerned with the present subject it may be added that the general result of this detailed investigation is that a definitely stronger growth of the offspring of young mother trees during the first few years, is almost lost by the end of the first decade.

1. *L. Tschermak* ... Centralb. f. d. ges. Forstwesen, 1924, pp. 201—283.
2. *Hartmann* ... *Loc. Cit.*, 1925, pp. 165—194.
3. *L. Tschermak* ... *Loc. Cit.*, 1925, pp. 270—272.
4. *Kraus* ... Boden and Klima auf Kleinstem Raum, 1911, p. 175.
5. *M. Schreiber* ... Centralb. f. d. ges. Forstwesen, 1926, pp. 45—59.
6. *H. G. Champion* ... Ind. For., Rec. XI, Part I, 1925.
7. *Dengler* ... Zeitsch. f. Forst u. Jagdwesen, 1926, pp. 124—126.
8. *Busse* ... *Loc. Cit.*, 1926, pp. 72—83.

H. G. CHAMPION, I.F.S.

RE-INFORCED CEMENT-CONCRETE WELLS AS CONSTRUCTED IN THE PILIBHIT FOREST DIVISION, UNITED PROVINCES.

There had been some difficulty in the past in sinking a well at two of the forest rest houses of the Pilibhit forest division, *e.g.* at Nawadia and at Nakhatal. Nawadia has a very deep water level and has a sub-soil (about 37′ deep) of loose ash and sand starting about 6′ below the surface of the ground, then there is a kankar pan striking rather irregularly below the water level. Consequently four successive attempts of constructing a brick well at this place had failed in past years. Nakhatal has mber of thick strata of big boulders both above and

below the water level, and consequently a number of trial borings for making even a tube well here had failed.

It was, however, very essential to make a well at each of the two rest houses, and therefore, a sum of Rs. 1,800 was provided again this year (1925-26) by the Conservator of Forests, Eastern Circle, U. P., for the construction of the two wells.

In connection with the construction of the Sarda Canal that passes through this division, the canal engineers had to construct a large number of wells, along the line of the canal, for the sake of their brick kilns and labour. Owing to the abovementioned features of the soil they had to face a lot of difficulties in making their wells and had, therefore, to try various contrivances to overcome the natural obstacles, especially in the neighbourhood of the abovenamed rest houses.

At mile 11 of the main canal they have constructed a re-inforced-cement-concrete well which has been the most successful of all other devices. A re-inforced-concrete cylinder with only 6" thick wall was easiest to sink, most economical to construct and quickest to finish; and re-inforced-concrete work is undoubtedly the most durable type of masonry.

The writer, therefore, made use of the experience gained by the canal engineers in sinking wells in this division, and studied the construction of the re-inforced-concrete wells in details for the sake of Nawadia and Nakhatal. The following notes in this connection may be of some use to forest officers interested in the construction of wells :—

1. *The mould.*—To begin with, a mould for making the well-cylinder has to be made. It consists of two tubular jackets (or hollow cylinders) made of galvanised iron sheets, one jacket being smaller than the other by 6" in radius (*i.e.*, by the thickness of the cylinder wall of the well). The smaller tubular jacket is placed inside the other to make up the mould, which thus has a cross section of two concentric circles. The space (hollow ring) between the two jackets is for moulding the well-cylinder wall. The height of the mould is 3'.

Making the mould.—Each tubular jacket of the mould is made up of two vertical halves which are joined together, to make up a circular tube or jacket, by means of bolts and nuts fitted at both the side-ends of each half of the jacket, an overlap of about 2″ broad having been allowed for the purpose at each end. Each half of the jackets is strengthened with angle iron bars which are rivetted into the upper and lower edges (excepting the space of the 2″ overlap left on each of the side-ends as mentioned above) along the outer circumference in case of the outer jacket, and along the inner circumference in case of the inner jacket. Then a through-hole about 1″ broad is made along a common diameter of the inner and outer jackets across the middle of the jackets, so that while using the mould a crow bar could be put through the two jackets combined, in order to keep them together in position every time the mould is fitted up.

2. *Composition of concrete to be used.*—One part of cement of good quality, two to three parts of pure and coarse sand, and four parts of stone ballast passed through a sieve of 1″ square holes, make up the dry mixture of the concrete required.

Small shingle or gravel collected from river beds will do very well. Failing stone ballast or shingle, broken chips of overburnt (jhama) bricks may be used.

NOTE.—Three parts of sand in the mixture takes longer to set than two parts, and it is better to mix only two parts of sand for the portion of the cylinder that is to be sunk below the water level

3. *Mixing the concrete.*—Make three tanks, with brick flooring, near the site of the well—two to be of about 25 c.ft. capacity, and the third of about 15 c.ft. capacity. Then mix sand and cement dry together in the small tank, and put ballast in one of the big tanks, wash it properly there, and then transfer it to the other big tank. Put the dry mixture of cement and sand at the top of the ballast and then pour clean water, and mix all the ingredients together to the usual consistency of concrete.

4. *Re-inforcing the concrete work.*—For re-inforcing the concrete work ¼″ thick iron bars will be required. Five to six rows of bars fixed vertically throughout the height, and arranged

equidistant from each other, round, and through, the middle of the cylinder wall will do. These vertical bars start from the bottom of the well-curb where their lower ends are rivetted into or looped round the iron plate tyre of the curb as described in para. 6 below. Also while building the cylinder a circular iron ring is put horizontally round the middle of the cylinder wall at every 6′ height, thus enclosing round all the vertical bars; the latter are then fastened to the former, at their points of contact with a bit of binding wire. As the cylinder is built higher and higher, short lengths of vertical bars are further lengthened by joining at the top ends other pieces whenever necessary.

5. *Digging the pit.*—The pit of the well is to be dug in the usual manner about 10′ wider than the proposed diameter of the well, or wider still according to the nature of the soil and other circumstances, in order to allow for making a scaffold round the cylinder for the workmen to stand upon while working. The depth of the pit, however, should not exceed 6″ above the water level, as if the water started oozing out it would be difficult to make a cement-concrete curb, and to start the building of the well-cylinder.

6. *Making the well-curb.*—First draw two concentric circles at the properly levelled bottom of the pit with diameters exactly equal to those of the large and small tubular jackets of the cylinder mould. Then make a brick mould, for making a curb, along the ring of the two circles in such a manner that the lower edge of the curb, when made, will be 2″ thick, the inside edge will slope up to 7″ thickness at the top for a dip of 8″, and the outside edge will be vertical. Then get a ¼″ thick and 3″ deep iron-plate tyre, of a slightly smaller diameter than that of the outer circle, made, and have the ends of 5 or 6 vertical iron bars of convenient lengths rivetted into, or looped round the tyre-plate at equal distances from each other, as mentioned in para. 4 above. Place this iron tyre, along with the vertical iron bars, inside the brick mould of the curb, and then put concrete in the hollow of the mould and ram it well to form a consolidated curb.

7. *Moulding the well-cylinder.*—Directly after the curb has been made, fit the parts of the cylinder-mould together, taking care that the nut ends of the bolts fitted into the overlaps are on the outer surface in case of the outer jacket and on the inner surface in the case of the inner jacket, so that when the mould is filled up with concrete the nuts could be worked from outside while undoing the mould. Pass a crow bar through the holes of the mould as mentioned in para. 1 above and then place the mould at the top of the curb making the centre of the mould coincident with the centre of the curb. The curb would thus have a stepping of $\frac{1}{2}''$ on each side of the well-cylinder, the top surface of the curb being $7''$ wide and the wall of the cylinder $6''$ thick. The vertical iron bars starting from the tyre plate of the curb will thus be sticking up through the middle of the hollow ring of the mould. Then fill the hollow ring with cement-concrete putting the latter in layers of about $1'$ deep and ramming each layer well every time. In order to have a collar joint for the next above section of the cylinder, a row of bricks on edge ($\frac{1}{2}$ brick deep from the top) is inserted along the outer circumference of, and inside, the mould. Then allow eight hours before removing the mould, during which interval the concrete will have set itself fairly hard. The mould is then taken off by pulling the crow bar out, undoing the nuts of the joints and then pushing the vertical halves of the outer and inner tubular jackets of the mould out. Also remove the bricks of the collar joint. Fit the mould up again and put it at the top of the solidified section of the cylinder to repeat the same process of moulding. Go on thus building the cylinder every time in $3'$ sections, making at the top of each section a collar joint as before for affecting a better binding with each of the next above sections. In this way a $6'$ cylinder can be built in a day, *i.e.* one section of $3'$ in the morning and one in the evening.

8. *Plastering the well-cylinder.*—Plastering should follow the building of a convenient height of the cylinder. Both the inner and the outer surfaces of the cylinder wall should be plastered with cement, at the same time the holes left by the crow bar of the mould should be filled up. For plastering the inside of the

cylinder a wooden platform for the workmen may be hung into the cylinder by means of a rope tied to the crow bar at the top section of the cylinder.

9. *Sinking the cylinder.*—After the cylinder has been built up to a height of about 15′ further moulding should be stopped but the cylinder mould should not be removed from the top section. Digging of earth inside the cylinder should then be started after removing the brick mould of the well-curb, and as long as the water is not deep, digging is continued with a hoe, after which a *jham* is to be used, and divers have to be engaged. As the digging work progresses the cylinder sinks down automatically by virtue of its weight, and in order to effect an even and vertical sinking, and also to quicken the speed, heavy bags filled with earth are placed at the top of the cylinder. After the cylinder has been sunk to a depth of about 3′ a fresh section of cylinder is added at the top, when again sinking is done to the same extent Go on repeating the process of sinking and moulding of cylinder alternately in three sections till it has been sunk to the required depth. After that build up the rest of the cylinder upto a height of about 2′ above the level of the ground, and then fill the pit up, all round the cylinder, with earth in the usual manner.

10. *Quantities of materials required and cost.*—For a 40′ deep cylinder of 4′ diameter and 6″ thick wall, 300 c.ft. of shingle or ballast, 150 c.ft. of sand, 70 standard size bags of B.B.B. Portland cement, and 1½ mds. of iron (bars, etc.) were used in the Nakhatal well.

Cost of material and making of the well will vary according to locality. In a difficult locality like Nawadia the total cost of a well of about 52′ deep cylinder (or 4′ diameter), 14′ of which has been sunk below the water level, came to Rs. 959.

NOTE.- 6″ thick cylinder wall will do for wells of about 6′ diameter, and for the larger size wells 9″ thick wall will be necessary for which a mould will have to be made accordingly.

M. Z. HAQ, P.F.S.,
Divisional Forest Officer, Pilibhit Forest Division.

MUSINGS WITHOUT METHOD.

Perusal of the article entitled "Recent Publications of the Indian Forest Department" in the February issue of the *Indian Forester* has aroused reflections in my mind of which as a loyal member of the Service I somehow feel I ought to be ashamed. While I ought to applaud all the good work done, and it *is* good work, I feel that much of it is to no particular purpose, save of advancement of pure science which I hold is no function of the Forest department *per se* The author of the article disappoints me by omitting to mention Bulletin No. 38 (New Series) "The Construction of Calcareous Opercula by Longicorn Larvæ of the group Cerambycini (Coleoptera, Cerambycidæ). The mere title of this bulletin singles it out for special mention. No other item out of the whole list, which as the article mentions is published bi-annually, intrigues me half as much and as I am neither more nor less than one of the rank or file there must be others who feel the same about it. The author of such delightful and concise nomenclature can only be capable of high achievements and I should have bought a copy to read but for the fact that it is coldly and officially valued at annas three only? My mind is in a torment and yet I tried to persuade myself that anyway it doesn't matter *to the Forest department* whether the little larvæ concerned construct calcareous opercula or whether they do not. Our valued colleague Dr. Beeson I hope will forgive me for selecting this item. His work and his great achievements are too well known to suffer from any remarks of mine and knowing him as I do for the scientist he is I certainly should not wish to give offence. There are many other publications about which I feel much the same but happily for my peace of mind a very large number are marked "out of print" and the powers that be apparently have come to the conclusion to leave the matter there. What are we to make of this? While on the subject of these official publications how comes it there no mention of one of the most important and revolutionary pieces of work ever undertaken in the history of the Forest department? I refer to the Aerial Photo Survey of the Irrawaddy Delta an account of which was published in Burma Forest Bulletin No. 11. True it did not

emanate from Dehra Dun but I make bold to say it caused more stir in the world than anything published hitherto except perhaps Troup's monumental work on Silviculture. Perhaps the reader will by now have decided that I write from Burma. I do, but let me at once disclaim any connection direct or indirect with the aerial surveys.

2. To revert to the original theme I feel that in the past we have spent too much time, and time is money, on side shows. Of course, critics will at once arise and tell me that teak, *sal*, *pyinkado*, deodar, etc., sell themselves and we want to develop the less important lines. The sal heartwood borer we are told causes a loss of 2½ lakhs of rupees annually and therefore it is obviously worth investigation in terms of Rs. a. p.; but then official estimates for the loss from the bee-hole borer of teak amount to (I think) 15 lakhs of rupees annually, yet for some reason or other no work worth mentioning has been done on it for several years. To take another example we know now that extracts from the bark of *Pinus Khasya* and certain parts of Burmese and Shan oaks make excellent leather. We have also suspected for many years that the available forests of these species are too small and too inaccessible for exploitation even on a small scale and probably not a pice of the thousands of rupees spent in investigating their tannin contents will ever be recovered. This brings me to my point which is that *as a commercial concern*, and this must always be subject to minor considerations such as provision of local requirements of fuel, etc. We ought not, except for special reasons, to spend money on research which will not in all probability repay us by raising the present income from the source under investigation by as much or more per annum as represents the interest on our expenditure plus sinking fund charges. To illustrate my point, if 2½ lakhs of rupees is the annual loss from the sal heart-wood borer we can calculate almost exactly how much it is justifiable to spend on its control. Also before we investigate tannins in mangroves for example we should calculate the approximate cost of the investigation--say one lakh of rupees (readers may think this an exaggeration ! if so I ask them to find out for themselves some actual figures from the Dehra Dun

archives)—and make up our minds beforehand whether the present annual revenue from mangroves is reasonably likely to be raised by Rs. 5,000 (the interest on Rs. 1,00,000) plus say another Rs. 5,000 towards wiping out our capital expended. The total will fall of course as time goes on but unless the probability of increased revenue is reasonably good, I hold our money ill spent. Mathematically inclined readers will be able to work out for themselves on these lines the probability of *commercial* success for the new Dehra, Clutterbuckganj, and other projects which will doubtless suggest themselves. On the other hand, 15 lakhs represents interest and sinking fund charges on quite a respectable amount which could be spent on the bee-hole borer!! If therefore we insist on our commercial basis we must look into matters very carefully before setting out on new schemes. Naturally risks must be taken but they must be such as would pass the directors of a limited liability company, *i.e.* the probable profits from success must largely exceed the expenditure involved. I should like to make plain my view that if we are prepared to admit that much of our expenditure on research is for the sake of research and for the advancement of the knowledge of the world, there is nothing but praise to give, but in that case I think we should ask Government for a grant to that end and not confuse it with money received for the commercial advancement of the forests. Before concluding on this subject I must emphasise again my desire to criticise merely the system and not any officer or group of officers.

3. Much the same criticism applies to forest education throughout India and Burma. I honestly believe too much money is spent on training both gazetted and non-gazetted staff and the thing has been getting worse instead of better. I know of a class of Rangers being taught to distinguish the different brands of Eucalypts; very important in the Nilgiris and probably nowhere else!! I know of a class of budding Extra Assistant Conservators of Forests who understood the meaning of "Ob-diplostemonous" but failed to define "Range" and I have read some serious correspondence as to whether or not the use of the theodolite should be taught to a class of forest guards on Rs. 8 per mensem!! Of course, these are isolated cases but readers can easily ascertain

for themselves from Annual Reports the actual money cost of training one Extra Assistant Conservator of Forests or one Deputy Ranger. Overhead charges such as those on capital cost of buildings, leave and pension contributions for staff, etc., etc., ought to come in but are not so easily obtainable. I think many officers who have not looked at the matter in this light will be surprised. Can we afford to go on at the present rate in the light of my financial test outlined above?

JUNIOR.

EXPLOITABLE GIRTH IN THE SAL FORESTS OF THE UNITED PROVINCES.

The sal forests in the United Provinces are situated along the foot of the Himalayas in varying conditions of soil, aspect, elevation, etc., from plains to about 3,000 feet above sea-level. As a rule, sal growth is very poor on sandy soils or on the southern dry aspects. But it attains good dimensions on well drained, fertile loamy soil in the plains or on the gentle slopes at the foot of the hills or along the banks of streams where trees of 6′ to 8′ in girth or even more are still found growing in perfectly healthy condition. Such trees are not very many, but they are found almost in every division in spite of the fact that a large number of bigger trees have already been felled in the past. Hence the presence of a few here and there shows that, in suitable places, the soil is capable of growing healthy sal over 6′ in girth, specially in Haldwani, Ramnagar, Kalagarh, Dehra Dun, North Kheri and Bahraich Divisions.

Under the old selection system, the exploitable girth of sal was 6′, which has been reduced to 5′ under the "Conversion to the Uniform System," now in vogue. This reduction in the exploitable girth for the crop, as a whole, is perfectly justified for various reasons explained in Mr. Collier's Haldwani Plan. But 5′ girth trees are not capable of producing large size beams, which have hitherto been extracted from these forests. Besides, it is the general idea of the public that sal below 6′ in girth produces

kacha, viz., immature timber, which is neither quite durable nor does it retain its shape.

It is, therefore, suggested that if a small number of healthy mature trees, say 2 to 3 per acre, be further retained at the final fellings, only in favourable localities, and be allowed to grow for the second rotation, they will supply the public with the large timber in demand, however small in quantity it may be, and at the same time keep up the reputation in the timber markets which sal has enjoyed in the past. The retention of this small number of mature trees (2 or 3 per acre), in particular places only, is not likely to interfere with the young growth below, nor will it make the crop non-uniform to any objectionable degree.

MD. HAKIM-UD-DIN, P.F.S.

CAUSES OF INFERTILITY IN SOILS IN RELATION TO BACTERIAL ACTION.

The March issue of "The Agricultural Journal of India" contains a note on causes of infertility in soils in relation to bacterial action. The theme formed the subject of a lecture by Mr. C. M. Hutchinson, C.I.E., B.A., Imperial Agricultural Bacteriologist which was delivered under the auspices of the Pusa Scientific Association and which was attended by many members of the Board of Agriculture which met at Pusa at that time.

The lecturer pointed out that, although infertility is a negative term suggesting the absence of elements required for fertility it is necessary to realise that infertility may also result from the presence of substances or conditions inimical to the growth of plants. Large areas of arable lands now under cultivation have come down from their original condition of high fertility as virgin soils to their present state of comparative infertility as a direct result of the artificial conditions of plant growth to which they have been long subjected. It is such lands which deserve particular attention, those in which the degree of fertility is so low that relatively small causes, or infertility factors may at any moment reduce their yield below the point at which it ceases to pay to cultivate them.

Water-supply ot course is a vital factor and must be taken account of both from the point of view of deficiency and of excess. Under unærobic conditions* due to waterlogging, the

* Deficiency of oxygen.

texture of the soil deteriorates and there also takes place a production of toxic bodies. Mr. Hutchinson stated that under the action of anærobic bacteria*, the decomposition of organic matter present in the soil gives rise to colloidal bodies† in the form of bacterial waxes and slimes which coat the surfaces of the soil particles, thus interfering with æration and drainage and retarding the important processes of nitrification of organic matter and solubilization of phosphates. It is important to realise that anærobism in soils tends to increase by reason of the fact that the anærobic classes of bacteria whose growth and preponderance result from the prevalence of this condition, are themselves capable of contributing to and increasing it by the production of colloids; thus the vicious circle is completed.

Besides harmfully affecting the soil texture, the existence of anærobic conditions is likely to give rise to toxic substances which may reduce fertility, either acting directly as plant poisons or indirectly by their interference with nitrification. A special case of anærobism is that produced by the growth of grasses, the closely interwoven roots and suckers forming a sod or layer not only relatively imperious but giving rise to extra quantities of carbon dioxide by their decay. It may also be noted that in some cases while the deficiency of the air supply of the soil may be of such an order as not to produce directly harmful action on plants, it may bring about a reduction of fertility due to the depression of nitrification processes.

Turning next to the relation of the above facts to agricultural operations, the lecturer pointed out that the principal function of cultivation is to produce a suitable balance between air and water-supply and thus promote formation of available, *i.e.*, soluble plant food, specially nitrates. Hot weather cultivation has other functions besides killing out weeds; this operation promotes soil aeration and effects improvement in

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* Bacteria which flourish in the absence of oxygen.

† Substances when they are made to attain a very fine state of division come to possess certain characteristic properties, *e.g.* inability to diffuse through a parchment membrane.

the sanitary conditions of the soil microflora. The destruction of the mechanical condition or tilth of soils by ploughing when wet is ascribed to the abrasion of the film of air which coats and closely clings to the soil particles. The air film plays an important part not only in the biological activities of the soil but in maintaining its physical condition and retarding waterlogging. Ploughing wet causes replacement of the superficial coating of air by water and the soil particles are brought into close and adhesive contact. Apart from the extremely deleterious influence of compaction upon the biological processes of soil, the penetration of plant roots is rendered more difficult.

The operations of drainage and irrigation are also intimately associated with problem of the regulation of water and air contents, the ideal aimed at being the maintenance of optimum amounts of air and water and the avoidance of anærobism.

Reverting to the problem of the supply of plant food materials, Mr. Hutchinson discussed in some detail the biological considerations which regulate the provision of available nitrogen and phosphates.

As to the choice of crops, it must be remembered that the selection of varieties is to be made with special reference to the depth of root range of the plant. A crop must be chosen whose root development fits in best with the soil air conditions.

In conclusion, Mr. Hutchinson rightly emphasized that so far as soil fertility is concerned, this condition or its opposite can never be ascribed to one cause alone but is associated with the interaction of several. A complete investigation of all the physical, chemical and biological factors operating in soils is necessary for any understanding of the problem. In this country especially, owing to the high soil temperatures which prevail during a large part of the year, and the correspondingly rapid bacterial change resulting therefrom, due recognition of the connection between soil fertility and soil bacteriology should be borne in mind,

J. S.

EXTRACTS.

A UNIQUE RECORD—FIFTY YEARS' GOVERNMENT SERVICE.

The auction room at the office of the Depôt and Agency Forest Division, Forest Road, Ahlone, was the scene of a unique function on Friday when Mr. Watson, Chief Conservator of Forests, other officers of the Forest Department, employees of the Department and friends gathered together to witness a presentation by the Chief Conservator to Mr. A. S. G. Michael, Shipping Clerk, in the office of the Conservator of Forests, Utilisation Circle, Burma, on the occasion of his completion of fifty years' service in the Department.

Mr. Watson, Chief Conservator, presided and after Mr. Robertson had explained the reason of the gathering, Mr. Watson addressed the gathering as follows:—

Rao Sahib Michael and Gentlemen,

Gatherings such as this for the purpose of recognising merit and doing honour where honour is due occur from time to time, but the occasion for this one must be rare indeed, if not entirely without precedent. We have assembled this afternoon to celebrate the jubilee of Mr. Michael who completed 50 years' service in the Forest Department on the 1st May, and to recognise the devotion to duty and sterling integrity of character which he has displayed throughout that long career. Mr. Michael joined the Department as daily labour clerk on the 1st May 1876 and now 50 years later in 1926 here he is still in harness, full of years and honours, discharging his duties with unabated zeal and vigour. That, gentlemen, is a record of loyal and faithful service which few indeed could hope to emulate. Mr. Michael's occupation is far from being a sedentary one, for the work of a shipping clerk is hard, involving irregular hours and being constantly on the move. In spite of this, however, Mr. Michael has taken only 14 months leave in 50 years. That, again, is a remarkable record. In June 1914 at the end of which month Mr. Michael was due to retire,

His Excellency the Vicerory conferred upon him the title of Rao Sahib as a personal distinction. Mr. Michael, however, did not retire, but had extensions of service for a further five years which covered the period of the Great War. In March 1917 he was attached to the Deputy Director of Munitions, (Mr. A. Rodger,) for work in respect of the supply of timber for war purposes to Mesopotamia, Egypt and Salonika. For his valuable services in this connection, His Majesty the King Emperor appointed him in 1919 to be a Member of the Order of the British Empire. Mr. Michael took his pension on 1st July 1919, but having then been working for 43 years he was unable to stop and has continued to work ever since.

Apart from his striking official activities Mr. Michael has constituted himself the Thos. Cook and Wm. Whiteley of the Department and there are few officers who have not availed themselves of his invaluable services in either or both capacities. When going on leave one hands over one's baggage to him with complete confidence that there is no possibility of any mistake being made, and on return, as the boat nears the wharf the first thing one looks for is this familiar figure waiting to relieve one of all the horrors which attend a disembarkation. They are no horrors to him, however, for he is the high priest of all the mysteries of the docks and can even perform the rites of the Customs House without any keys. As Wm. Whiteley, he is the Universal Provider and I have never heard of his being non-pulsed by any demand, be it for a perambulator or for a butler. It is said that on one occasion he was requested to supply an anchor but Mr. Michael was undaunted and produced six assorted specimens for inspection within 24 hours.

When the time comes, as come it must, for Mr. Michael to lay aside his manifold activities, the Forest Department will lose the services not only of a loyal and devoted servant but also of an obliging and faithful friend.

I trust that time may be far distant, but when it does come Mr. Michael will retire with the best wishes of us all and we hope that he may be granted many years of honourable old age in which to enjoy his well earned rest.

And now, gentlemen, it is my pleasant duty to ask Mr. Michael's acceptance of these tokens of our esteem—a gold watch and chain and a scroll. The watch is inscribed as follows:—

A. S. G. Michael from friends in the Department.

The scroll reads as follows :—

"Presented to Rao Sahib A. S. G Michael, M.B.E., together with a gold watch and chain on the occasion of his completing 50 years' service in the Forest Department in Burma, 1st May 1876 to 1st May 1926."

"This presentation is made by friends in the Department in recognition of his loyal and faithful service and sterling integrity of character."

Mr. Michael replied as follows :—

"Ladies and Gentlemen,

"I have to thank you sincerely for all your good wishes on my attaining the 50th year of service in the Forest Department, and the valuable present. It is really a unique occasion when the officers and clerks meet together one of their own who had been in the Department for no less than half a century. I thank God, ladies and gentlemen, for my being gifted with a strong and healthy body. I thank you ladies and gentlemen for in your company I have so to say found pleasure. I thank you more so now for your happy thought of meeting me to-day.

"I thank you, sirs, the Minister of Forests, the Chief Conservator of Forests, all Conservators of Forests and Forest Gentlemen and my co-workers on this unique day. I hope you will remember me even if I should not be healthy enough to be amidst you again."

The presentation over the gathering dispersed only to gather round small tables where tea was served, the catering being by that well-known firm the Vienna Café, after which they returned to their homes.

Mr Michael was the recipient of many personal congratulations.—[*Rangoon Times.*]

ROYAL AGRICULTURAL SHOW.

KING'S INTEREST IN FORESTRY EXHIBITS.

An enthusiastic reception was accorded to the King and Queen on the occasion of their visit on Tuesday to the Royal Show, which after a period of forty-four years, is again being held in Reading. The King and Queen were much interested in the Forestry Section, and particularly in the exhibits of the Forestry Commissioners. These included a number of working models, linked by a miniature railway, and together they gave an idea of the work of afforestation in different parts of the country. The King followed the various phases in the history of a tree after it has been felled. In addition to a model of a felling area was one of a wire ropeway worked by electricity used for transporting timber across the River Wye, another showing how logs are cut by machinery, as well as a veneer machine. The operations of each were watched by the King, who also examined the model of a wood distillation factory, and the products of distillation. Finally he inspected the model of a house which was intended to show the amount of foreign timber used in building construction. This led to a number of questions by the King on the progress of afforestation in this country. The Queen was especially interested in the samples of artificial silk made from spruce; and in the Forestry Section the beauty of artificial silk fabrics was appropriately shown in an exhibit by Courtaulds Ltd. The mahogany exhibits also aroused her keen curiosity, and Her Majesty was informed of the many uses to which this wood is put.—[*The Timber Trades Journal.*]

STANDARD METHODS OF ANALYSIS OF FERTILISERS.

Dr. J. Sen, M.A., Ph.D., Bio-Chemist at the Forest Research Institute, Dehra Dun, contributes a highly technical but interesting paper on the "standard methods of analysis of fertilisers." In his prefatory remarks Dr. Sen observes that reports on the composition of agricultural products at times show relatively wide divergences even when the analyses are carried out by specialists

unless the same standard methods are adopted. In view of this fact, the First Conference of Agricultural Chemists and Bacteriologists, held at Pusa in 1919, adopted a resolution recognising the necessity for the standardisation of method of analysis. A Standing Committee was appointed to investigate and report on methods applicable to specific materials. Investigations of each of the fertilizer constituents was distributed to sets of workers chosen from among the members of the Committee. It was decided that reports in critical studies of existing methods and of the new methods as they appear were to be transmitted to the Secretary to the Committee for circulation. The reports were considered at the Second Conference of Chemists and Bacteriologists which met at Pusa in 1921, when certain methods were accepted as official, while certain others were temporarily adopted as provisional.

Dr. Sen goes on to add :—" A Committee was formed to prepare and circulate details of the proposed standard methods for analysis of fertilizers. It was hoped that before the next meeting of the Conference, which was to take place in 1923, it would be possible to thoroughly test these methods in the different Agricultural Chemical Laboratories, and that it would thus be possible to have all the standard methods in shape for final acceptance at the Conference. As unfortunately no Conference of Chemists and Bacteriologists has been held since 1921, the Imperial Agricultural Chemist undertook to circulate the final report to agricultural chemists and other scientists interested in the subject throughout India. The consensus of opinion being in favour of publication of these methods, this is now being done, after considering the individual points raised." It is pointed out that the methods are largely based on the Official and Tentative methods of analysis published in 1920 by the Association of Official Agricultural Chemists of the United States of America. The work is monumental and its value has been universally acknowledged. But the American procedure has had to be considerably modified in view of the different conditions prevailing in India. The Bulletin deserves well at the hands of Agricultural Botanists.—[*Capital.*]

7

BIRDS AID AFFORESTATION

In a lecture on " Birds and Trees," broadcast from the Liverpool station on Wednesday, Mr. W. A. Edwards, the local Hon. Secretary of the Royal Society for the Protection of Birds, said that little was commonly known of the indispensable place and work of birds and trees in the scheme of Nature. In all parts of the world experience showed that a district denuded of its forests became sterile. But trees themselves would not survive at all without the services of birds, and the insect-eating bird was of much greater value than any chemical dressing. In Canada, in the course of three years, insects were responsible for the destruction of more timber than would have sufficed for the Dominion's paper industry for twenty-nine years. Experience proved that if the various afforestation schemes were to be successful the services of wild birds were absolutely essential. But while the old woodlands were ideal homes and nesting-places of wild birds, the new plantations, consisting of young larches and firs without old wood or undergrowth, provided neither nesting sites nor food supply. The future of British wild bird life seemed to depend, therefore, upon the setting apart of each forestal area as a safeguarded and permanent sanctuary, and also upon the provision of nesting boxes and other encouragement in the new woods.- [*Timber Trades Journal.*]

"WOOD STOCKINGS." R. L. S. AMERY ON THE USES OF TREES.

"The time is not far distant when the forests of the world will be depleted to make stockings," said Mr. L. S. Amery at the annual dinner in London of the Timber Trade Federation.

If he were a poet he would compose something about "the slender pine dreaming through the long winter of those fair limbs which some day it might both cover and reveal."

Timber was our protection against cold, and our mental nourishment. Every morning we nourished our minds with news on sheets which came straight from the forests of Newfoundland or Sweden.

From those sheets we learnt how incompetent was the Government, and how dangerous were the operations of certain financial gentlemen from the United States.

And who knew that the nourishment of our minds from timber might not be followed by the nourishment of our bodies? Science might produce synthetic bread and synthetic beef, and we should then learn to ask quite naturally at a railway station buffet for our hard-wood sandwich.—[*Westminister Gazette. Reprinted from the Pioneer.*]

PURCHASE OF WOODLANDS IN DRUMTOCHTY BY THE FORESTRY COMMISSION.

The Forestry Commission has purchased the hills and woodlands of the well-known estate of Drumtochty, in Kincardineshire for the purpose of afforestation. Before the war, the beautifully wooded glen of Drumtochty was one of the most picturesque spots in the North, and constituted one of the most admired stages of a popular tour in the country. After the war broke out the sound of the woodman's axe rang merrily amongst the giants of the glen, and the pretty woodlands were shorn of their glories. Now, however, the acquisition of the hills and glen by the Forestry Commission promises that not only will their pristine beauty be restored, but, from the view of unemployment, extensive planning operations likely to be immediately embarked upon will prove gratifying.—[*The Timber Trades Journal.*]

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INDIAN FORESTER

DECEMBER 1926.

TIGERS IN BURMA.

(*Continued from "Indian Forester," pp.* 555—561, *November* 1926.)

Elephants.—Tigers frequently kill elephants. Generally they kill calves which the mothers seem quite unable to protect, but occasionally full-grown females are killed. This year one of the big firms of lessees has lost several calves and at least one full-grown female. It would be very interesting to know how a tiger kills an elephant. Probably he jumps on it and eats it while still alive, and the animal dies of its wounds after many days. In the Lower Chindwin I once had a full-grown female badly mauled. She was scratched all over the body. In this case I think the aggressor was not a tiger but a leopard, and that the elephant had gone too near a leopard with young. There is no doubt that the flesh of an elephant is very sweet to the tiger.

Other domestic animals.—Immense damage is done by tigers in killing other domestic animals. The animals generally killed are buffaloes, bullocks and cows, but tigers are especially fond of ponies and pigs, and kill them if they get the chance. At several villages in the Upper Chindwin I was told that they used to keep ponies but could not do so now, as the tigers killed them all. Last year a tiger actually killed a pony in the pound at Paungbyin in the Upper Chindwin district. In recent tours through the Minbu, Pakôkku, Lower Chindwin, Upper Chindwin and Katha districts I have asked at all villages where I halted whether they had lost any cattle through tigers. Except in the dry zone areas

of these districts and in the case of large towns such as Homalin (and even here I was told that tigers had killed cattle within three miles of the town) the almost invariable reply was that cattle were frequently killed. At one village in Pakôkku and another in the Lower Chindwin I was told that on an average a cow was killed every night. At one tiny hamlet in the Upper Chindwin where the total number of cattle was only four, one had been taken by a tiger about a fortnight previously. I only remember one large village in this district where they said that they had no losses from tigers. When cows are killed the damage done is perhaps not very great, but it often happens that it is not a half-starved cow that is killed. Very frequently the victim is a full-grown timber-dragging buffalo in his prime. I have known tigers frequent the neighbourhood of saw-mills both in the Shwebo and Tharrawaddy districts and regularly kill the big bull buffaloes that were used for dragging the logs to the mill. A tiger seldom kills a big buffalo outright but generally bites through the tendon above the hock and the unfortunate animal is partially anchored and dies dragging itself about or lying in a wallow for several days.

In such cases a tiger will frequently make a full meal off the living animal without killing it. Last year near Paungbyin in the Upper Chindwin district I was told that a tiger had been heard attacking a buffalo at about 6 o'clock in the evening on the edge of a swamp in thick *kaing* grass. Next morning I visited the spot and found a full-grown buffalo still alive. The tiger had eaten the whole of the rump and the entrails were exposed. Burmans never kill a buffalo when mauled in this way, and I have been shown these animals on several occasions. Burmans are extremely careless about looking after their animals and one frequently finds buffaloes living out in the jungle for weeks, miles away from any village, in some of the most tiger-infested places in the Upper Chindwin. A full-grown buffalo is worth Rs. 100 or more and the loss from this cause throughout the country must be enormous.

The inaction of the Burman in not taking measures against cattle-killers is in marked contrast to his usual prompt action

when a man is the victim. In many villages, a large proportion of the villagers do not desire the tiger to be killed. The owners of the cattle are of course glad if the tiger is killed, but the other villagers are not. There was genuine regret at the death of a large cattle-killer which was in the habit of killing a buffalo about once a week at Sityin in the Lower Chindwin district. The people are Buddhists and cannot kill any domestic animal, but if their cattle are killed by tigers they obtain a supply of meat without incurring any sin.

Wild animals.—Tigers kill nearly every kind of wild animal from elephant and bison downwards, but their chief meat in Burma is sambhur. They kill tsine (*Bos Sondaicus*) and bison by the same method that they kill buffaloes. I have seen a tsine with his hock badly damaged by a tiger and the only big blue tsine that I have ever seen was killed by a large tiger in the Bassein district. Tigers are very fond of porcupines and actually chew up the quills into short pieces about an inch long and swallow them. These quills pass right through the body and it is difficult to understand why they do not pierce the intestines. The number of sambhur killed by tigers must be enormous. Let us suppose that the 6,060 tigers killed during the nine years 1916 to 1924 had not been killed, but had lived only two years more, and had then died a natural death. Let us further suppose that each of these tigers killed during these two years one animal a week. We arrive at the conclusion that by killing these tigers the lives of over 600,000 animals were saved. Estimating that the tigers destroyed each year are ten per cent. of the total tiger population in Burma and estimating that the survivors kill one animal a week we arrive at the conclusion that some 400,000 head of game are killed annually. The above figure is probably very much underestimated, but is some slight indication of the immense amount of damage done by tigers to game. It is perhaps a paradox, but there is a good deal of truth in the saying "the more guns the more game." Sooner or later the presence of a gun in the forest means the death of a tiger, leopard, wild dog, or other carnivorous animal. Recently two guns paid a ten day visit to a big reserve in the Upper Chindwin. During these ten

days the bag was two tigers, two pigs one sambhur, two barking-deer, and two wild cats. Allowing that the tigers and wild cats would have lived two years more if they had not been shot and allowing that they would have killed one head of game each per week during these two years, we arrive at the conclusion that by shooting these tigers and wild cats the lives of two hundred head of big game were saved in the case of the tigers, and two hundred head of jungle fowl, pheasants, etc. in the case of the wild cats, or far more than the sportsmen would ever have shot in a lifetime.

The good done by tigers.—In books dealing with India one reads that if the tigers were all killed off, the fields of the poor ryot would be over-run with pig and deer. This does not apply to Burma. In Burma where wild elephants are plentiful they do immense damage to the crops and the Burman cultivator cannot prevent this damage. Damage done to the crops by other animals is not very serious. Pig, sambhur, thamin, and hog-deer do a certain amount of damage in places where they are plentiful, but the Burman does not object to their presence as he nearly always manages to take toll of them and he would give a good many baskets of paddy for the sake of a chance of bagging a pig, as pork is his favourite dish.

The only other advantage that there is in tigers being plentiful is that they afford a chance to sportsmen of bagging one. Accompanying the shooting of a tiger there is none of the regret that one feels when one kills a fine old bison or elephant. Tigers are not very easy to get, and in consequence they are more appreciated than if they were too easy to obtain. Weighing up the disadvantages with the advantages I must admit that the former are overwhelming, but on account of the pleasure they give by their deaths it is to be hoped that the day is long distant when tigers shall be at all scarce in the Province. At a Conference of Conservators of Forests held at Maymyo in May 1925 the majority of those present were of the opinion that tigers should continue to be looked upon as vermin and that the rewards at present paid for their destruction should continue. Since 1903 tigers have cost the Government of Burma Rs. 420,872 in rewards. Would ny fewer tigers have been destroyed if these rewards had not

been payable? In very many cases the tiger would have been shot or trapped even if no reward had been payable. I have made the acquaintance of men in the jungle who made their living by trapping leopards for the rewards, but I have never met a man who made a regular business of killing tigers. Many Burmans will set a trap over a kill but except in the case of man-killers I do not think that any Burmans exist who will carry the war into the enemy's country and tie up cows for tigers to kill. On the average in the twenty-two years tigers have cost the Government of Burma Rs. 19,130 a year and somewhat reluctantly I must admit that the reward should continue to remain in force.

I think that the issue of poison to village headmen should be discontinued. There is no objection to poisoning wild dogs but a tiger deserves a better fate. Apart from the undesirability of a dangerous poison being obtainable by village headmen all the various tribes who inhabit Burma will cut up and eat any dead animal they find, and there will be a wholesale catastrophe if the practice is allowed to continue. Last year in a Shan State the son of the Sawbwa set a gun over a tiger "kill" and posted up notices in Burmese and Shan warning persons not to go along the path. An illiterate Chin came along and was seriously wounded. If instead of a gun having been set, this carcase had been poisoned he would have probably taken quantities of meat away to his village and the whole village might have been wiped out.

Tigers in Burma appear to differ from those in India not only in the number of men they kill, but in several other ways. They are probably much smaller animals. The largest tiger I have ever heard of killed in Burma was one shot by Mr. E. H. Peacock, Divisional Forest Officer, Upper Chindwin Division, in January 1926 in the Palin Reserve on the left bank of the Chindwin river. This tiger measured 9′ 3″ between the pegs and was an extremely massive animal with a forearm of 21 inches. Several tigers longer than this one have been shot in Burma, up to 9′ 6″ between the pegs, but they cannot compare with Mr. Peacock's tiger which was exceptionally massive.

In Burma there are no hyenas and jackals are very scarce. Owing to the dense jungle it seldom happens that vultures find a tiger's kill and it is probable that tigers are much more scavengers than in India. The only vulture which seems able to find a kill in dense jungle is *Otogyps calvus*. One does not see these birds in large numbers on a kill in the jungle but there are frequently two of these birds on a kill no matter how dense the jungle in which it is hidden. They probably find a kill by watching the movements of the crows. Tigers have no objection to eating putrid meat, and by the time an animal has been dead for some time it frequently happens that several tigers will have found it. Tigers are not able to run a trail like a dog, but there is no doubt that they can wind a dead animal over a long distance. If one wishes to shoot a tiger in Burma, the best way to do so is to kill a pony or a cow and peg it down. In a very few days the body will be found by one or more tigers. There is no doubt that tigers find a dead cow very much quicker than they find a live one. On Xmas day, 1925, I shot an old pony and pegged it down in the Shwebo district. It was found that same night by a tiger, and in all three tigers visited the body. I also had three cows tied up at other points of the compass from my camp but none of these living cows was found in ten days.

Much has been written recently both in the *Field* and in the Journal of the Bombay Natural History Society about the calls made by tigers. Tigers in Burma would appear to be much more vocal than those in India, especially in making the bell-like noise somewhat like that made by a doe sambhar. The Burmans call this noise "Tit." Tigers make this noise very often under the same circumstances that a barking-deer barks, that is to say, when they encounter any unexpected object. I have known a tiger make this call on finding that an ordinarily unoccupied rest-house was occupied. Tigers make this noise when they see a very bright light being carried along in the jungle. It is probable that this call is also used by tigers to inform each other of their whereabouts.

There is also another call used by tigers which would appear peculiar to Burma. In Burma when one tiger wishes to call

another it makes use of a call which is quite different from the sambhar-like noise. This call is not at all loud and is best described as "Tak." Sometimes this is a monosyllable but is frequently combined with "Urrgh." This is a mating call and if one tiger is shot and there is another in the neighbourhood, directly the living tiger misses its companion it calls "Tak urrgh," not very loud but rather staccato. I have never seen this call described before in books dealing with tigers in India or elsewhere.

S. F. HOPWOOD, I.F.S.

RELATION OF RATE OF GROWTH TO STRENGTH IN TIMBER.

[*Acknowledgment*:—The photomicrographs for this note were made by Mr. J. H. Warr, Officer in Charge of Wood Preservation, from slides of which the three for figure 1 B (Plate 11) and figure 4 (Plate 14) were prepared by Dr. H. P. Brown, Wood Technologist. The remaining slides were prepared by the writer.]

In the May 29th issue of the *Timber Trades Journal* there appeared a very interesting note by Messrs. Hale and Brophy of the Forest Products Laboratories of Canada on "The Effect of Rate of Growth on the Strength of Softwood Timber." The facts dealt with agree so exactly with conditions existing in Indian conifers that it is thought worth while to repeat here extracts from their note.

Starting with a reference to the "layered" nature of timber familiar to everyone, the writers proceed to discuss the microscopic structure of the different layers and its bearing on the weight and strength of the wood, as follows:—

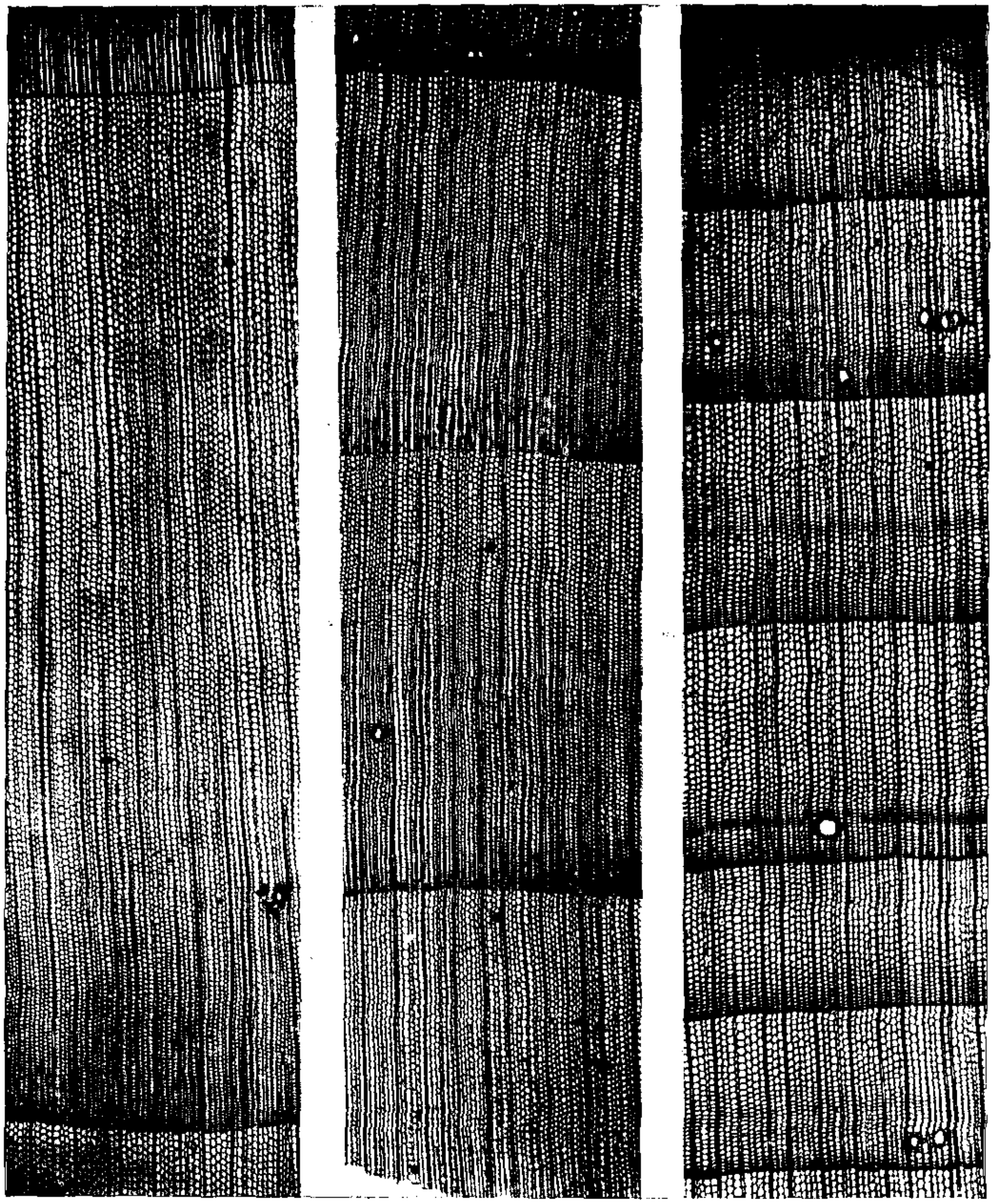
"Wood is composed of cells, which are chiefly fibres. The fibres vary in length from about one millimetre to six or even eight millimetres. This length may be from twenty-five to one hundred and fifty times the diameter of the fibres. Wood fibres are hollow tube-like structures with ends which are closed and more or less blunt. Packed close together with their long axes parallel to the axis of the trunk or branch whose wood they compose, the fibres and other wood cells, by the combination of their own properties, determine the properties of wood."

"If wood cells were all of uniform dimension, wood structure would appear homogeneous and the different annual layers would not be distinguishable from each other. The seasonal changes in northern latitudes, however, exert a marked effect upon the cell growth, an effect manifested by a decrease in size of those wood cells which are formed near the latter half of the growing season. In the springtime growth is fast and the fibres which are formed at this time have a large diameter, but, as has been noted, the fibres formed later in the season (during the summer) are of smaller diameter and have thicker walls. The wood formed in summer, being composed of thick-walled fibres, with comparatively small cavities, is denser and harder than the wood formed at the beginning of the growth period. As during the winter the tree is dormant and no additional growth takes place, the successive annual layers are sharply defined by the contrast in texture and colour of hard summerwood of a previous ring which abuts the softer springwood of the subsequent year's growth."

"RATE OF GROWTH SHOWN BY WIDTH OF ANNUAL RINGS.—Only softwoods will be discussed in this paper. Softwoods form the bulk of Canadian forests, and include all the needle-leafed trees, usually spoken of as "evergreens," or conifers. Their structure is simpler than that of hardwoods, and for this reason they are best discussed separately. The annual rings of this group are often more strikingly divided into springwood and summerwood than is the case with hardwoods, and therefore the softwoods offer more favourable material for studies in growth rate."

"It is obvious that a tree which continually forms wide annual rings will increase its volume more rapidly than one which adds only narrow layers. Wood with wide rings is, therefore, spoken of as fast-growth material, and that with narrow rings is said to be slow growing."

The bearing of the summerwood content on the strength of coniferous woods is evident from figures 1 and 2 (Plates 11 and 12), in which the large thin walled cells of the springwood may be seen to comprise relatively much less wood material, and

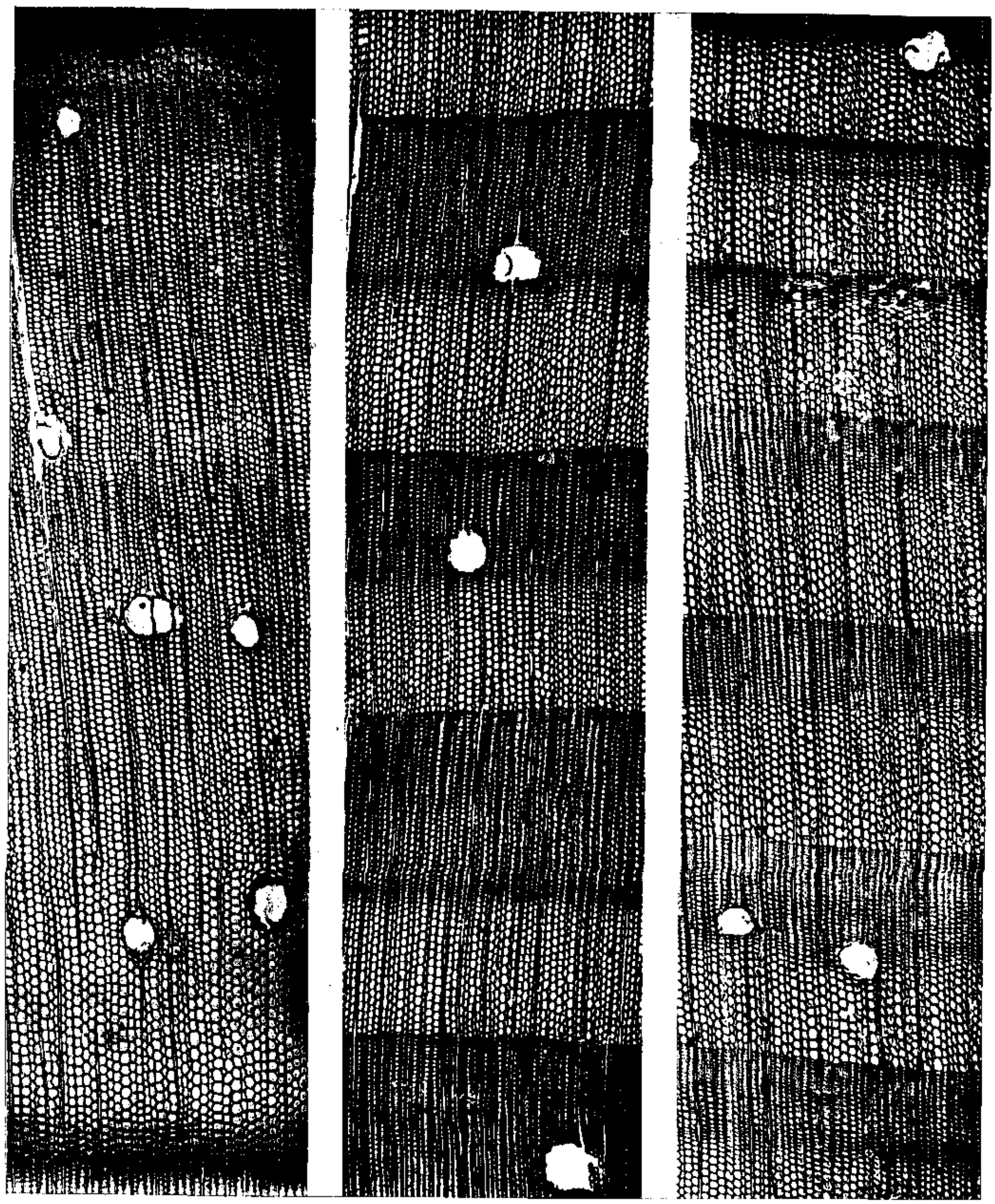


A
RAPID GROWTH

B
MEDIUM GROWTH

C
SLOW GROWTH.

FIGURE 1.
PICEA MORINDA.



A
RAPID GROWTH

B
MEDIUM GROWTH

C
SLOW GROWTH.

FIGURE 2.

PINUS LONGIFOLIA.

consequently much less weight and strength than the smaller thick walled elements of summerwood.

Omitting the data found in the *Timber Trades Journal* because it relates to timbers which are not found in India, we shall proceed to apply the same treatment to Indian species. For this purpose *chir* (*Pinus longifolia*) may be taken as a typical example of a conifer with sharply differentiated springwood and summerwood, and Himalayan spruce as one in which the dense summerwood gradually merges into the more open, lighter springwood. Figures 1 and 2 (Plates 11 and 12) show clearly the structure of these two timbers, and figures 6 and 7 (Plates 16 and 17) express the relation of strength and weight or specific gravity to rate of growth.

These graphs demonstrate what the photomicrographs indicate, namely, that optimum strength in *chir* is associated with a growth rate of 12 rings per inch, while in spruce the slower the growth the greater the strength, because, in the former the relative area occupied by the stronger fibres is greatest in the material of medium growth rate, while in the latter this condition is found in the material which grew most slowly.

The article mentioned above summarises these facts as follows (relating to conifers only) :—

"(1) The strength of timber is approximately proportiona to its density ;

"(2) The density of timber (and therefore its strength) depends, to a great extent, upon the rate of growth of the tree which produces it ;

"(3) There is an optimum growth rate for the production of the best quality ;

"(4) The optimum growth rate may be quite different in different softwood species ;

"(5) Softwoods, such as Douglas fir, larch, and certain hard pines which have a high proportion of hard summerwood, have an optimum rate of growth which is more rapid than the optimum rate for such woods as spruce, balsam fir, and white pine, which have less conspicuous summerwood ;

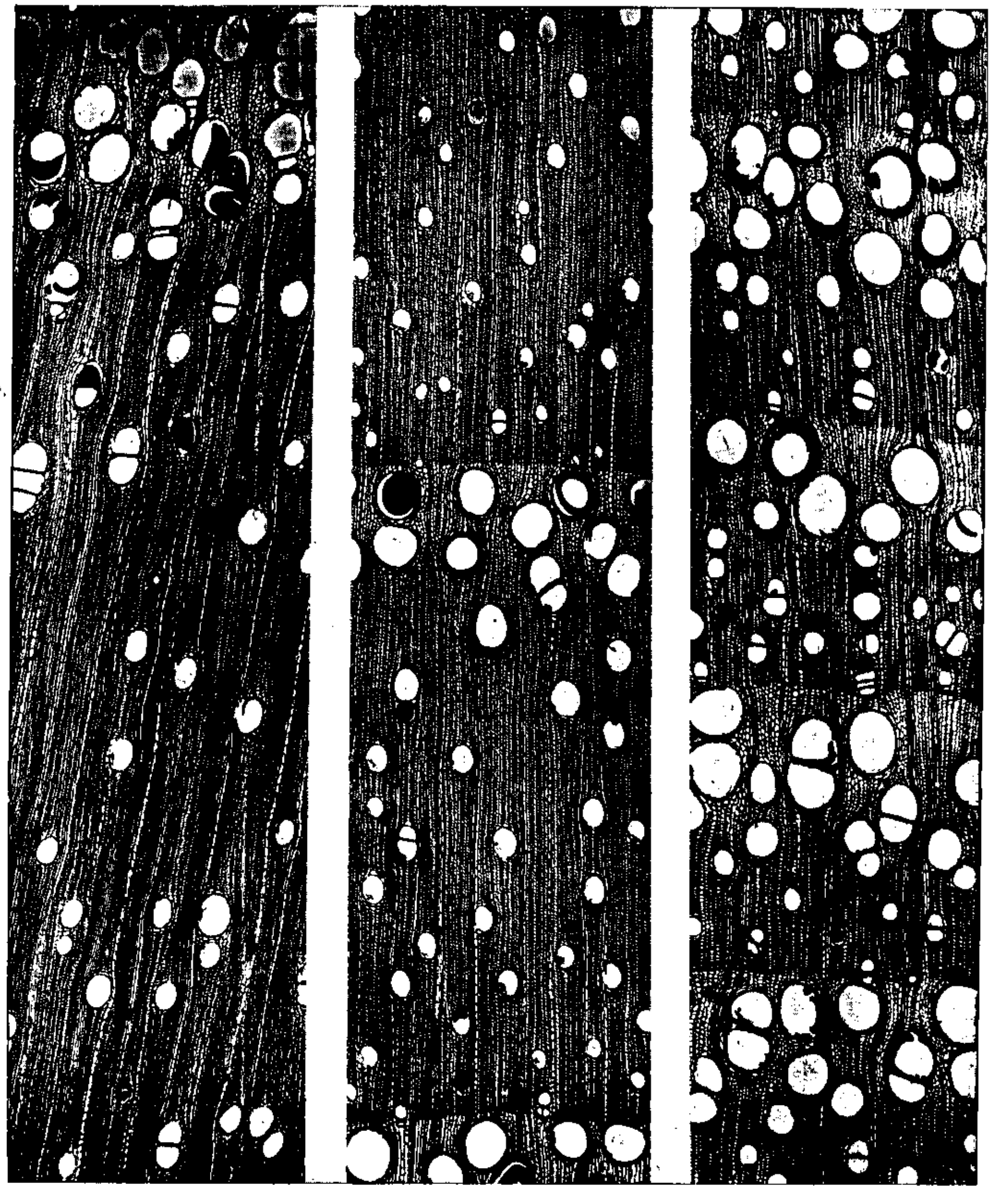
"(6) The falling off in strength, due to very slow growth, is less than the reduction due to very rapid growth."

RING POROUS WOODS.

The problem in India, however, does not end with the conifers with their relatively simple structure. On the contrary the majority of Indian timber species are of the porous, or dicotyledonous variety. The conifers may be regarded as of early origin (the Palezoic period) when large areas of the earth's surface were subject to nearly constant, mild climatic conditions and nature's only care was to provide for existing growing conditions. The conifers of to-day are only the few survivers of the vast family which existed at that time.

The dicotyledonous trees, on the other hand, are of comparatively recent origin in point of geological time, nature's latest effort to accommodate tree structure to modern climatic conditions. They are correspondingly more complicated in the development and functions of their various elements, which have been adapted on one hand to the necessity for food storage during unfavourable seasons, and on the other to rapid transportation of that food to its allotted destination at the season when growth is most vigorous. For this purpose certain of the elements have developed into relatively large tube-like structures called vessels in the wood, generally associated more or less with thin walled cells which also function in relation to the supply or carriage of nourishment. These vessels, seen on the cross-section of the wood, appear as openings, and are commonly spoken of as "pores," whence is derived the term "porous wood."

For the purposes of this discussion we shall treat porous woods under two classes, ring porous and diffuse porous. Ring porous woods are more commonly associated with localities having fairly distinct seasons, either by reason of change of temperature or of moisture, in consequence of which the trees have definite periods of vigorous growth alternated with rest periods. In the earlier periods of vigorous growth most of the energies of the tree are bent to growth in length, and large supplies of food in solution are hastened to the growing points. At this period



A RAPID GROWTH

B MEDIUM GROWTH

C SLOW GROWTH.

FIGURE 3.

CEDRELA SERRATA.

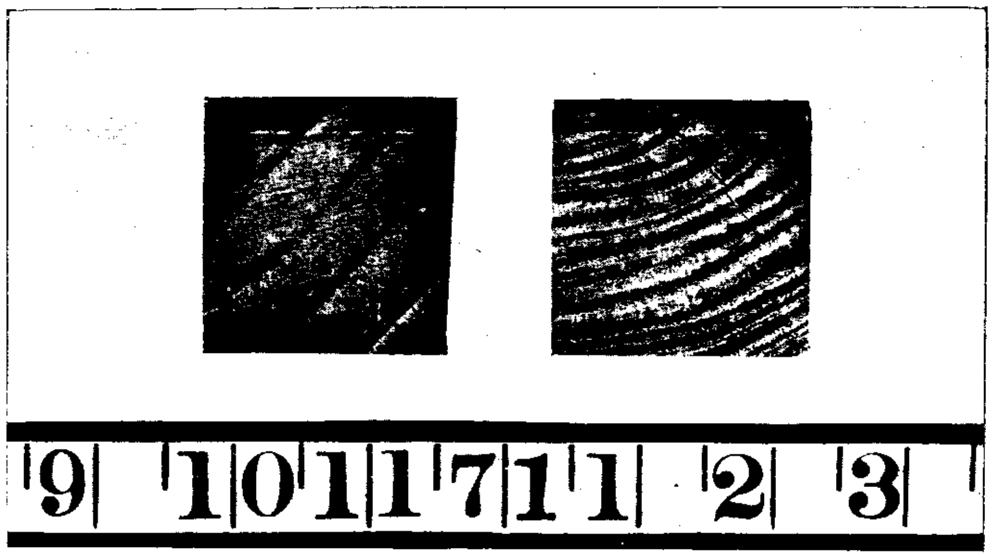


FIGURE 5.

SHOWING RAPID & SLOW GROWTH CEDRELA SERRATA.

large vessels and thin walled fibres are copiously produced. Later in the season the development of the mechanical strength necessary for the safety of the plant becomes paramount. Fewer and smaller vessels are produced, and a large number of thick walled cells whose function is to supply mechanical strength are formed. As this cycle is repeated year after year the wood in cross-section presents a banded or layered appearance as illustrated in figure 5 (Plate 15) which affords an example of rapid growth and of slow growth *Cedrela serrata*.

In figure 3 (Plate 13) which shows cross-sections of the wood magnified about 15 times, the structural characteristics of *Cedrela serrata*, a good example of ring porous wood, can be seen, as developed in rapid, medium and slow growth. In the early portion of each year's growth-rings are found the large pores, surrounded by open thin walled cells, while later in the season the wood contains fewer and smaller pores, and its cells are smaller and thick walled, both changes affording weight, and, at the same time, more strength. It is evident that B in figure 3 (Plate 13) suffers less loss of strength through the area occupied by pores and thin walled cells than either A or B, while both A and C are plainly weakened by the large amount of room taken up by the pores and weaker elements. The graphs in figures 6 and 7 (Plates 16 and 17) show how tests have demonstrated that the optimum growth rate of *Cedrela serrata* for the production of the heavier, stronger wood, is from 3 to 5 rings per inch and the reason is evident from the structure of the wood shown in figure 3 (Plate 13) to which reference has already been made. In the medium growth wood the bands of large pores and thin walled cells are no wider than in the slow growth, and hence the proportion of dense, strong wood in each annual ring is much greater. In the rapid growth wood, on the other hand, the bands of weak material are a good deal wider, and in addition there are larger pores dotted about among the dense wood, producing a further weakening effect. It is impossible for want of space to show at this magnification an example of the most rapidly grown *Cedrela serrata*, but the weakening effects just referred to in

discussing rapid growth become more accentuated in the very wide annual rings sometimes found in this species.

These features apply in varying degree to all ring porous woods, but all species do not necessarily have the same optimum rate of growth. They are, however, all similar in that the optimum growth rate for ring porous woods is more rapid than in conifers.

DIFFUSE POROUS WOODS.

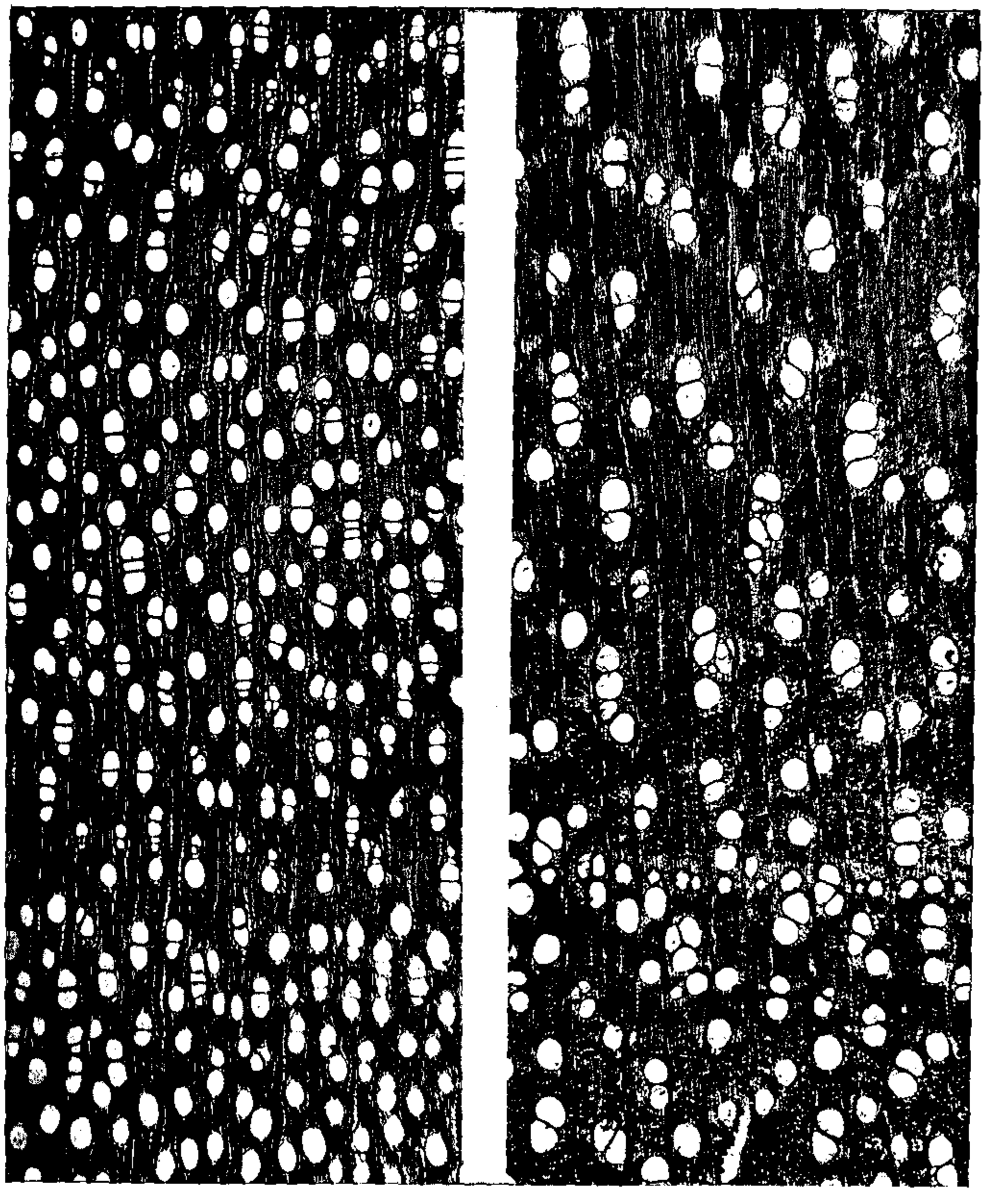
A great many of the Indian timbers are diffuse porous, and annual growth rings can be distinguished with difficulty, if at all. Trees of the tropical and sub-tropical forests show a distinct tendency, on account of the equable nature of the climate in which they grow, towards homogeneous structure. Examples of this class of wood structure are shown in figure 4 (Plate 14), which presents *Anogeissus acuminata* and *Hopea parviflora* at the same magnification as the other photomicrographs accompanying this note. In these the pores are scattered diffusely through the wood, and rate of growth produces no appreciable effect on their arrangement nor on the relative proportions of dense wood and of open thin walled cells.

The curves for density and strength of *Hopea* have not been included, but in figures 6 and 7 (Plates 16 and 17) the curves of strength and weight for *Anogeissus acuminata* show how strikingly the effect of the structure is reflected in results of tests. The changes in these properties with different growth rates are so small as to be negligible.

SUMMARY.

The results of this study up to the present may be summarised as follows :—

1. In general the varying rates of growth of trees produce in conifers, varying proportions of thick walled strong cells, and of thin walled weak cells, and in ring porous woods, varying proportions of open porous wood with accompanying thin walled cells and of the denser wood which is formed in the latter portion of the growing season.



A B

FIGURE 4.

ANOGEISSUS ACUMINATA. HOPEA PARVIFLORA.

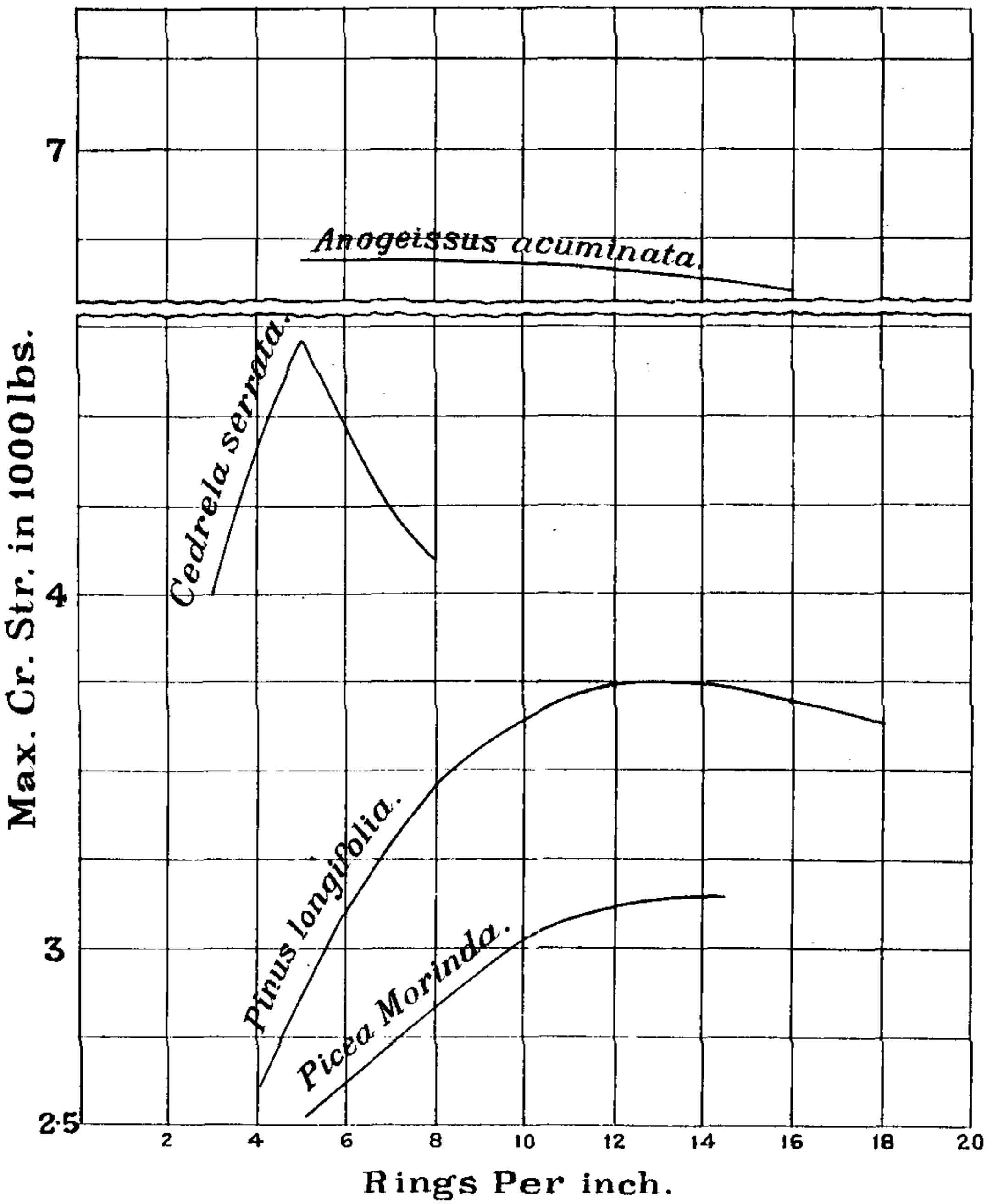


Figure 6.

Photo. Zinco. October, 1926.—No. 1005 900

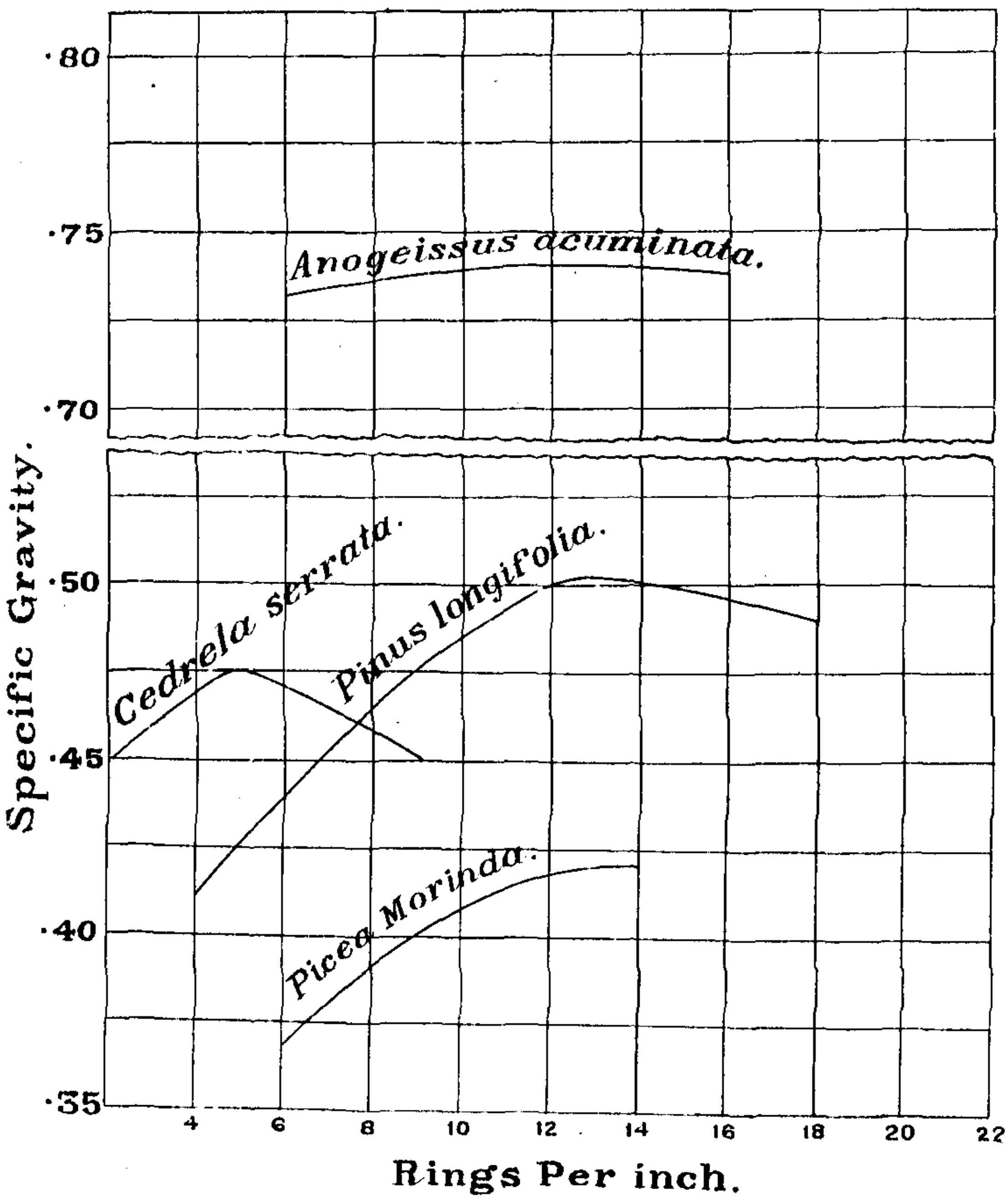


Figure 7.

Photo. Zinco. October, 1926.—No.1009-1. 500

2. These growth characteristics are reflected in the density and strength of the wood, and different species have different optimum growth rates.

3. In conifers the tendency is to produce the best material at the slower rates of growth. Those species, like *chir*, in which the summerwood shows the most marked contrast with the spring-wood, reach their optimum at a more rapid growth rate than do the others, like spruce, in which the contrast between the early and late growth of each year is less pronounced.

4. Ring porous woods tend to produce their best material at more rapid growth rates because there is little difference in the amount of weak, open porous wood produced each year, the wide annual rings, consequently, containing a higher proportion of dense tissue. It is only when the growth is excessively rapid that the optimum is passed because of the appearance of more and larger pores with their accompanying thin walled cells.

5. There is no evidence up to the present to prove that growth rate has any material influence on the strength and density of diffuse porous woods. These species have a very uniform growth rate, and what variation there is does not seem to be reflected in their structure, which is much more homogeneous than that of either of the two former classes.

L. N. SEAMAN,
Officer in Charge, Timber Testing Section.

HILL FROSTS AND PLAINS FROSTS IN THE UNITED PROVINCES AND THEIR RESPECTIVE EFFECTS ON SAL.

I will try in this short article to draw distinctions between two different types of frost met with in the sal forests of the United Provinces and will attempt to show their respective effects on sal. One type of frost I will call the hill type as it affects the sal in the valleys both narrow and broad (duns) of the outermost Himalayan and Siwalik ranges. The other I will call the plains type because it affects sal in the plains,

Hill frosts are met with throughout the submontane divisions of Dehra Dun, Lansdowne, Kalagarh, Ramnagar and Haldwani, wherever valleys are so situated that cold air accumulates and does not rapidly drain away.

The reasons for this inferior drainage are worth consideration. In the first place the general direction of the air currents at night in sub-Himalayan tracts is, during the cold weather almost invariably from the hills to the plains or roughly north to south. These general air currents are strongest and most persistent along the valleys of those rivers which rise among the central and inner Himalayan ranges and the larger the river the stronger and more persistent are the air currents which it conducts. It follows that in the side valleys running east and west the drainage of air is likely to be much retarded, and if the entrance to the side valley is narrow or at right angles to the main valley then the flow of air may be almost completely arrested. It is in valleys of this nature that the most severe frosts occur and the sal suffers most in consequence. As examples to prove my statement I may cite the Adnala and Baidanala, two small tributaries of the Palain river in the Kalagarh division. The Palain flows roughly in a southerly direction whilst the two side streams mentioned flow west and meet it at right angles. In the case of the Adnala the angle which the valley makes with the portion of the Palain valley immediately above its junction is even greater than a right angle. In both cases the air currents are arrested and severe frosts result. The cold air undoubtedly fills up such valleys like water in a rising lake, since it cannot escape with the same rapidity as it collects. Consequently we often find that the greatest damage occurs near the bottom of the valley whilst the sides of the valley are comparatively untouched. My recent observations in the above-mentioned Adnala valley seemed to show that sal was severely cut back by frosts up to 2,500 feet elevation, that there was then a zone above this, comparatively free from frost damage, which again became pronounced at 3,000 feet elevation. The 2,500 feet level is explained on the assumption that this is the highest point to which air below

Fig. 1.

Fig. 2.

Fig. 3.
EFFECT OF FROST ON SAL.

freezing point normally accumulates in this valley during years of exceptional cold. The reappearance of severe damage at 3,000 feet elevation may have been due to the rise in altitude or it may more likely have been due to some unobserved factor such as aspect.

From the foregoing remarks it will be seen that the cold air envelops the trees of the forest completely, just as completely in fact as they might be submerged by a rising lake. The tops of the tallest trees will be subject to as great or nearly as great a degree of cold as the seedlings on the ground and consequently damage will be just as great in the crowns of the larger trees as amongst young plants and saplings. That this is actually the case can be easily proved by observation, and it will be found that the frost kills back the leading shoots irrespective of the size of the tree. But there is one point about these frosts which must not be overlooked. They only occur at intervals of several years and the interval may extend to 20 or even more years. There is certainly no question of an annually recurring frost. It is for this reason that natural regeneration has no difficulty in establishing itself or in eventually reaching the normal height to which the locality would otherwise permit. When a frost year does occur the leading shoots throughout the forest will be cut back and moreover the protection afforded by the shelter of a neighbouring tree will, in the worst frost areas, be insufficient to save the growth beneath from a similar fate. Generally speaking the tallest trees seem to suffer most and plate 18, fig. *1* of a sal tree in the Adnala valley bears out this statement. This particular tree was situated on a south-east aspect at 3,000 feet elevation and is typical of the way trees are cut back by frost at long intervals of years enabling them to produce strong, erect, epicormic branches to replace those killed by the frost. Plate 18, fig. 2, was taken at 3,500 feet elevation on a south aspect in the Gola valley of the Naini Tal division. Here the crop is composed of *chir* (*Pinus longifolia*) and sal in about equal proportions, but practically every sal has been cut back by frost, like the one depicted in the photograph, in spite of the fact that many of the sal were growing beneath the shelter of the *chir*.

Before leaving the question of damage done by frost in the hills I should like to remark on the similarity of effect which may be produced by suppression followed by removal of the overhead canopy. Plate 18, fig. 3, shows an example of this. The tree photographed might easily be thought to have been affected by frost. In fact the only point about it to raise one's suspicions is the way the main stem has bent over to one side, the result of one-sided suppression. Actually this one-sided suppression is a very common occurrence in the hills owing to the reduction of light on the hill side and to the way in which trees on a slope tend to grow in tiers one above the other. The photograph was taken at 2,500 feet elevation in the Kansar block of the Kalagarh division and the stump of a large sal tree which had been the cause of suppression was still plainly visible.

In the case of sapling and pole crops the effect of hill frosts is somewhat different. The single leader is in some cases cut back, or the whole tree may be killed. The unsoundness which results in the former case is described in some detail by me in the *Indian Forester* for October 1923 in an article entitled "Frost as a cause of unsoundness in sal" and again by Mr. Hopkins in the *Indian Forester* for May 1924. The latter affirms that in the Ramnagar division alone about 3,000 acres of young sal are so affected by frost as to be totally unsound. The loss of a leader is invariably accompanied by the loss of numerous side shoots, and though the leader is quickly replaced the trees usually adopt the characteristic form of the Lombardy poplar. An excellent photograph showing trees of this form is given in fig. 46 of Troup's "Silviculture of Indian Trees."

I will now pass on to the plains frosts. This type of frost is seen at its worst in the Pilibhit and South Kheri divisions where the ground is practically level. The frosts in these tracts are of annual occurrence and they are only entirely absent at intervals of many years. Moreover the frosts are what may be termed ground frosts. They usually kill back all growth which does not exceed 5 feet in height, and in a bad year saplings in the open are killed back up to 10 feet. But though frost is ordinarily limited to air strata within 10 feet of the ground the tempera-

ture on the surface of the ground may drop to at least 21° F. as I discovered when carrying out a series of experiments in the cold weather of 1908-09 in the South Kheri division. The results of these experiments, which have been reproduced in the current working plan for the South Kheri division, also showed that the minimum temperature in the open was about 6° F. lower than in the adjoining forest and that the sal shoots were usually affected by frost immediately the temperature dropped to freezing point. The result of these ground frosts in the open is effectually to prevent the sal from growing up into a sapling, though in mild seasons, such as 1921-22, some of the sal shoots escape and, given a succession of mild seasons, may eventually establish themselves. The shoots are cut back to ground level year after year, but the root stock persists and gradually assumes striking proportions. Such open spaces covered with coarse grass and sal coppice and surrounded by forest are termed "chandars" and an excellent description of them is given by Troup on pp. 91 and 92 of his "Silviculture of Indian Trees." There are also excellent photographs of "chandars" depicted in figs. 21 and 22 of the same book. Their origin is an interesting but much disputed point and I will not enter into any such discussion here.

I have explained that within the "chandars" or open areas sal is almost completely prevented from making any headway, but in the adjoining forest the crowns of the trees remain unaffected and the protection afforded by the overhead cover is sufficient to enable reproduction to grow up into a sapling. It is only in very exceptional years such as 1904-05 that frost does any damage in the forest itself, in this year the forest was observed to be affected up to a height of 35 feet.

The peculiar nature of the Pilibhit and South Kheri frosts : peculiar on account of the regularity with which they recur and their restriction within such narrow altitudinal limits, is possibly explained by the fact that these tracts are situated some 30 to 50 miles from the base of the hills within a comparatively short distance of the right bank of the Sarda river. The Sarda is an immense river rising amongst the snows of Nandadevi and Trisul and since these main ranges are invariably snowclad during the

winter months it follows that the air currents which drain their slopes will always be extremely cold and will not be subject to much variation from year to year. The volume of cold air which flows down a river of this magnitude cannot but have considerable influence on the climate far out into the plains and there seems to me small doubt that we have here an explanation, at least in part, of the regularity with which frosts recur in the tracts under discussion. The very level nature of the ground would help to account for the restriction of frost within such narrow altitudinal limits over such a large area.

In conclusion frosts and their effects on sal in the United Provinces may be differentiated as follows:—

Hill frosts.	Plains frosts.
Frosts occur only at intervals of several years.	Frosts occur annually.
In a frost year the frost reaches the tops of the trees, the whole forest being submerged in a frost blanket.	The annual frosts seldom reach a point exceeding 10 feet from ground level.
Both large trees and young plants are equally affected in a frost year, but growth is never kept in a permanent state of coppice.	Only young plants and coppice shoots are affected and in open places the growth is maintained in a permanent state of coppice.

A. E. OSMASTON, I.F.S.

PRESERVATION OF MINING TIMBERS.

Aristotle said "close calculation is a shabby thing" but without decrying his philosophy it is safe to say that were Aristotle in business to-day, he would like the rest of us, make his calculations to the nearest reliable figure and then allow a little margin for safety. Whether we admit the shabbiness of it or not modern conditions have changed the old time slogan from "survival of the fittest" to "survival of the soundest" and soundness is based on "close calculation."

2. Just as the strength of each link has its effect upon the condition of the chain as a whole so the economies effected in any one department of an industrial concern are reflected in the improvement of the position of the undertaking itself.

3. The quantity of timber used may only be a small item compared with the amount of material produced but it is not a negligible item in the cost of production and could it be cut down to one quarter the effect would certainly be apparent at the end of the financial year.

4. It is not a difficult matter to do it, yet so far it has not been done in India.

5. A study of the subject in Europe shows, quite conclusively, that the economy of timber used in mines is regarded by the leaders of the industry as of prime importance, yet the conditions under which it is used do not differ in any marked manner from those under which it is used in India to-day.

6. It is a well-known fact that in certain galleries destruction by fungus is so rapid that timbers are normally replaced in from 6 to 12 months.

7. It is not likely that, at the depth at which these galleries are run, any factors other than decay, fire, and mechanical destruction will come into operation and these are the same the world over.

8. The case is, however, different where surface works are considered, as the introduction of another factor, *viz.*, insect attack modifies the applicability of certain preventives.

9. In Europe, by far the commonest timbers used are those of the conifer class although on the continent itself oak and beech are also used. Most of the Indian hardwoods are superior in strength to the conifers and can, therefore, be readily pressed into service.

10. It only remains to make them durable.

11. The normal timber in use is cut from stout saplings which are cut to length but have the sapwood ring entire, merely the bark being taken off.

12. It is the sapwood which decays so rapidly that in a few months the pole is useless as a compression member. Even sal and teak posts are reduced to a heartwood "pencil" in a very short time. In order to compensate for this waste the prop must originally be of much larger diameter than would be necessary were the whole of the prop durable.

13. It is quite a simple matter to make the sapwood of any timber durable as it is this portion of the timber which

is so readily permeable to preservatives of all descriptions.

14. Were heartwood alone used, the matter would be very different as some species absolutely refuse to take antiseptics in the duramen.

15. As mentioned above the choice of antiseptics for use underground is very large as the only limiting factor is fire, and among those which may be used with confidence are Powell solution, Wohlman Salts, Zinc Chloride, Syllit, Atlas solution, and if the fire hazard is not great any of the oil preservatives with Coal or Wood Tar Creosote as the basis.

16. By far the cheaper of these latter is creosote itself used with or without an admixture of Earth oil.

17. With regard to fire hazard it is noteworthy that in the North of England, when preserved pit-props are used, creosote is invariably employed and engineers consider that no additional risk is entailed.

18. In Germany many mines use Wohlman salts exclusively and these are undoubtedly effective but Zinc Chloride is extensively used also. A ten year life treated is regarded as an average against less than 12 months untreated.

19. As regards the method of applying the preservatives everything depends upon the quantity of timber to be treated.

20. With less than 200,000 cubic feet as the annual requirement the open tank process is quite effective.

21. Sapwood is readily impregnated to a satisfactory depth by this method and the apparatus required is simple and inexpensive. The process is however slow and should a larger quantity than the above be required, it is preferable to instal a small plant by which the timber may be impregnated under pressure.

22. It is not advisable to use a simple brush treatment as, should the timber already be unsound the outer coating of preservative is quite useless.

23. Although mention has been made above of props only the applicability of preservation is not confined to these. A large quantity of timber, in the form of slabs, is used for revetment and this can quite readily be treated with consequent economy. It is

not urged that every piece of timber used in the mine should be preserved, as much of it is used temporarily and is either withdrawn or abandoned after a short time. It is, however, strongly recommended that the preservation of timber in permanent galleries be given very close consideration.

24. Although no actual experiments have been carried out at Dehra Dun with the specific object of testing jungle woods as mine props we have treated many hundreds of sal posts with the object of economising in the fencing of the experimental plots at the new Research Institute.

25. Our oldest experiments have been running for nearly two years and the posts are as sound to-day as when they were first erected. Untreated, the posts would have needed renewal by this time.

26. The posts were treated under pressure with a mixture of equal parts of Creosote and Earth Oil; about 6·5 lbs. of oil per cubic foot. being left in the sapwood. The posts contained about two-thirds cubic foot of wood and it is estimated that the cost of treatment would work out at less than 8 annas per post or 10—12 annas per cubic foot, while it is confidently expected that the life will be increased ten times.

DEHRA DUN :
1st September, 1926.

J. H. WARR,
Officer in Charge,
Wood Preservation Section.

THE LOST GOLDMINE.

The D. S. P. and I were on tour together. He had in the club one evening expressed a wish to get off the beaten track, just to show the remote jungle dwellers that there really was a nice long—and shall I say—muscular arm of the law to protect them should they ever require it or to chastise them if they inclined to evil ways. So I offered my company and a share of my elephants and late one afternoon as the chill of the cold weather evening began to replace the mild heat of the day we left the railway and made our way towards the foothills where we intended to camp for the night leaving the climb over the forest clad range for the next

morning. The path led through alternate jungle and cultivation and the Police man, like the true sleuth hound that he was, stalked in a masterly way the unsuspecting parties of jungle fowl that wandered incautiously across our path and did terrible execution among them.

The distance as usual proved greater than the estimate given by our friend the headman of the village on the railway and it was after dark when we reached the camping place. In a few minutes, however, the tent was pitched, a crackling fire started and it was not long before we were lying back in our camp chairs under the glittering dome of the sky gazing into the leaping flames and chewing the cud of contentment induced by a long walk and a good dinner.

Next morning we pushed into the hills and two days later we came to the place. The village nestled by a rockstrewn torrent and was called the village of the Goldsmiths, while up on the hill above was the large rambling old bungalow where the gold diggers had lived. The bungalow had been built of stout seasoned teak and still stood firm and untouched by time. On the walls one could see where pictures had hung; in the bedrooms were great gaunt bedsteads and the dining room had a table that would have seated half a dozen Olympians. As we wandered through the rooms the spirits of the departed miners seemed to hover round us.

Next morning two old men from the village came and offered to show us the way to the mine. They remembered the days when all was bustle and activity, when the jungle resounded with the noise of the crushing machines and the population of the village ran into hundreds. Down the hill at the back of the bungalow we came on a pathetic heap of iron debris, overturned trucks, wheels, huge plates, all rusting away and disappearing gradually into the all devouring jungle. This had been the terminus of the little railway that brought the rock from the mine mouth two miles away. We proceeded along the old track which followed a small stream and led into the forest reserve. The jungle was of the wildest description, fallen bamboos and a tangle of creepers had completely obliterated what had once

been a railway and the only survivors were the rough hewn teak sleepers half buried in the ground on which the rails had been laid. We had to cut every foot of the way and the two miles took us as many hours. Presently the ground began to rise, we entered a cutting and coming round a corner we saw before us a yawning oblong of blackness that might have been the mouth of the nethermost pit. From the entrance our electric torches failed to penetrate the gloom for any appreciable distance, so we began to make our way gingerly into the tunnel the roof of which was sparingly supported by timber props. Presently the roof disappeared and we found ourselves in a lofty chamber into which far above our heads penetrated a chink of day-light. This our guides informed us was a vertical shaft which had been sunk long ago before the English miners came. The hill into which we were now penetrating was called the Hill of Gold and men had dug into it in search of the precious metal from time immemorial. We crossed the chamber and entered the tunnel on the farther side but soon afterwards it ended abruptly and we found ourselves on the edge of what appeared to be a bottomless chasm. Into this we dropped a stone and presently the sound of a faint hollow splash came up from far below. Here was the sudden end of the lode and into this chasm it had faulted, none knew where.

It was a relief to see daylight again and as we emerged I noticed, what I had not seen before, the tracks of a tiger passing in and out of the tunnel. I wondered what would have happened if we had found him at home.

Back in the bungalow we meditated on the grim and ceaseless struggle of human effort against Nature. Down below us on a little mound bordering the paddy fields and within sound of the gently murmuring stream were three graves where slept those who had tried to wrest Nature's secret from her and had given up the unequal fight. The westering sun sank abruptly behind the hills throwing up great beams of orange light into the sky. Far away to the north loomed the faint grey outline of the Divide which stands between Burma and the Unknown.

"CHIM."

REVIEWS.

INVESTIGATION INTO THE PROGRESS OF HEIGHT GROWTH IN TREES.

Dr. Hans Burger, Professor Engler's successor at the Swiss Forest Research Institute at Zürich has recently published * an account of his investigations since 1898 into the magnitude and duration of height growth of the commoner European forest trees. The research merits some attention and the following extracts and remarks have been made :—

He first deals with the effect of such factors as the weather locality, age of plants, and country of origin of the seed, on the annual increment, and summarises his conclusions under 9 heads as follows. 194,100 measurements were made on 2,912 plants growing in three localities. Measurements were made every second to fifth day, four plants being measured for every set of conditions.--

(1) The height increment is mainly decided by the quantity of reserve materials accumulated in the *previous* year and therefore indirectly on the weather of that year, in a way depending on the species and the locality.

(2) No direct relation between the weather of the *current* year and the height growth during it, can be

* Mitt. d. Schew Centralanstalt f. d. forstl. Versuchswen Vol. XIV, 1926, pp. 29—158.

demonstrated, though the *duration* of height growth is very dependent on the weather experienced, the reserves being more rapidly utilised under conditions favourable for the locality and the species.

(3) The height increment is mainly dependent on the locality (though not unaffected by the inner constitution of the species). Duration of growth in conifers is not closely dependent on the locality as is the case with broad-leaved trees.

(4) Both increment and duration of growth vary with the age of the trees.

(5) The origin of the seed exercises a very great influence on the annual increment and still more on the duration of the growth season, and the inherited constitution of local races shows itself fairly pronouncedly through the effects of the factors of the new locality. Races of spruce, pine and larch in 15—20 years (even in 50 years) have not yet adapted their original periodicity to the local conditions, but broad-leaved trees are rather more adaptable.

(6) Seasonal conditions hardly affect the order in which the several species commence growth, delaying or hurrying all proportionately.

(7) Conclusion of growth appears to be only indirectly influenced by inner constitution and takes place at very different times; few species seem to utilise the full climatic possibilities.

(8) The periodicity of the Michaelmas shoot is not yet fully elucidated, but it is evident that the duration of the spring growth is influenced by the weather during the growing period and the formation and increment of the later shoots is connected with the locality.

(9) It is considered as proved that the periodicity is not conditioned solely by inherent factors nor by the factors of the locality, but is the expression of the interaction of the two.

The main problems still to be solved are whether reserve materials of one year can be held over for a longer period than to the next year only, and to what extent the assimilation products of a year can be utilised for height growth during the same year.

There is little special comment to be made on these deductions among which the first two are the most interesting. It will probably surprise many to learn that growth during a season is hardly affected by the season's weather. One would like to have data on this point from India, and also as to whether temperature, or precipitation exercises the greater influence out here. For No. 7 it might be suggested that growth may stop because reserves are exhausted, recently manufactured supplies being for unknown reasons not available. The Michaelmas shoot is paralleled by the second maximum in the year's height increment curve found by Howard to occur for such species as *Eugenia Jambolana, Bombax, Ougeinia* and possibly *Dalbergia Sissoo.* No. 6 seems contrary to popular belief as crystallised in Europe in the verses about the leafing of oak and ash.

The second part of the memoir deals with the actual course of the height growth during the season, and deductions which can be made from the data collected. This section is summarised thus :—

(1) Height increment in all species is closely paralleled by the temperature curve.

(2) Rainfall affects the increment curve very irregularly and as temperature is usually simultaneously affected by rain, its effect is difficult to analyse out. In very dry years, it is clear that rainfall will restore a falling increment curve even more rapidly than might be expected.

(3) It could not be demonstrated that atmospheric moisture affect growth. Here again temperature is much influenced and dryness in soil is probably correlated with dryness of air.

(4) Sunlight also could not be shown to exert an independent influence.

(5) Mean curves for several years show that for any species the course is but little affected by temperature and other external influences; but is rather characteristic of each species.

(6) These periodicity characteristics may be assumed to have originated where the species evolved and so data are available for locating the original home of possibly exotic species.

It would hardly be surprising if the increment curves should follow that of temperature most closely, once we have learnt that growth is the result of utilisation of reserve materials: metabolism being mainly chemical processes, its rate should be more or less proportional to the absolute temperature, granting no transportation difficulties or inhibiting factors: when the growth takes place in the monsoon, adequate moisture will usually be present. Yet the one clear case known to the writer, that of Mr. B. B. Osmaston's measurements of the growth of new culms of *Dendrocalamus giganteus**, it was most strikingly brought out that growth at night or during rain is over 50 per cent. greater than during a clear day.

Trotter† and Howard ‡ have published data for the periodic height growth of a number of common North India trees, but they are not comparable with Dr. Burger's figures nor are they representative of normal forest conditions, the plants measured being in the first few years of their life and growing in nursery beds either irrigated or influenced by irrigation. It is proposed to repeat the measurements on trees not less than 4 or 5 feet high growing without irrigation.

H. G. C.

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* Indian Forester, 1918, p. 53.
† loc. cit. 1922, p. 640.
‡ loc. cit. 1924, p. 11,
loc. cit. 1925, p. 72.

A MANUAL OF FOREST MENSURATION, REVISED BY C. E. SIMMONS, I.F.S.

PUBLISHED BY THE GOVERNMENT OF INDIA, CENTRAL PUBLICATION BRANCH, CALCUTTA, 1926.
PRICE RS. 3-14-0 OR 6*s.* 8*d.*

This book is a revised and enlarged edition of the Manual of Forest Mensuration, by R. S. Troup, and like its predecessor is intended mainly for the use of Ranger students at the Imperial Forest College, Dehra Dun. Although it has been practically rewritten, the present edition, with a few additions and amplications, follows closely the arrangement of the original. These additions together with the larger and perhaps clearer illustrations are mainly responsible for the greater price of the book. Smaller illustrations, embodied in the subject matter as in the previous edition, would have kept the price down, without impairing its usefulness, and it is probable that this would have made the book more acceptable to Ranger students.

The most important of these additions is a new chapter on the measurement of earthwork. Since the submission of road estimates is a common duty of many Range officers this new chapter is welcome, particularly as the methods explained are simple and straightforward. Two methods are explained, namely one for hill roads with outside pegging and one for plains roads with centre pegging. In the case of hill roads calculations of earthwork depend only on the cross slope and the back slope or "batter." The former has to be measured to the nearest 2 degrees, and the sectional area is then read off from a table in which allowance is made for back slopes varying from $\frac{1}{4}$: 1 to $\frac{1}{2}$: 1. In the case of plains roads a rough graphical method is employed in which the width and side slopes or "batter" constant for a given road are drawn on squared paper. On a piece of tracing paper various lines representing different cross slopes are drawn radiating from a point. This paper is placed over the standard diagram on the squared paper and the number of squares between the particular cross slope of a section and the standard width and side slopes of the road can be counted and this gives the cross sec-

tional area of the road. This is a quick, simple and straightforward method that gives results sufficiently accurate for the purpose of ordinary earthwork estimation. This chapter is liberally provided with diagrams and is a useful addition to the Manual.

Another addition is a chapter on volume tables and the inclusion of the volume tables for chir and sal in the Appendix. This chapter was omitted in the previous volume owing to the fact that the method of volume measurement by tables was inapplicable in India at the time. But subsequent advances in this direction have made omission of this impossible. The general method of preparation and use of volume tables is explained and also a method of preparing a Local Volume Table from a General Table. This latter is useful in that general volume tables are often inapplicable to a particular forest, and although only those Rangers employed on working plans are likely to use it, this chapter makes the book more widely valuable.

The chapter on Stem Analysis and Ring Counting has been entirely rewritten and emphasis is rightly laid more upon stem analysis than on ring countings, although the latter has in no way been neglected. Stem analysis is always a perplexing and muddling matter unless viewed in the right way and this new addition should certainly make the subject clearer to Ranger and other students.

A notable omission is that there is nothing on the subject of yield tables. It may be argued that this is wise on the ground that yield tables hardly enter the province of Rangers, but owing to the greater importance now attached and paid to yield tables in India the inclusion of such a chapter would make the book more widely useful without placing it above the heads of Ranger students for whom it is primarily designed.

At the price the book is on the whole well printed and the diagrams clear although they often inevitably appear opposite the wrong pages so that reference to them from the text is at times made annoying. The book should prove of considerable value not only to students at Dehra Dun and elsewhere but also as an elementary reference work to Divisional Forest Officers.

F. C. O.

ORCHARD HEATING IN CALIFORNIA.

By WARREN R. SCHOONOVER and ROBERT W. HODGSON, in co-operation with FLOYD D. YOUNG of the United States Weather Bureau (University of California Printing Office, Berkeley, California, 1925.)

Considerable losses have been caused to the important and extensive industry of fruit culture in California by low winter and spring temperatures. This has led to a wide-spread interest in orchard heating and a demand for fuller information concerning methods and costs of protective measures, against damaging temperatuaes. This pamphlet embodies the results of a survey by the College of Agriculture, University of California, held in the autumn of last year, of the practices, costs, and results of orchard heating.

The greatest and most frequent losses occur with ever-green sub-tropical fruits, which never become completely dormant, and which mature their crops during the winter months. Weather records show that at periodic intervals frosts occur over wide areas, resulting in complete, or partial, destruction of the year's crop. These losses react not only directly on the fruit grower and the consumer in the form of smaller returns and higher prices but also indirectly on the community, through reduction of working capital and consequent loss of employment by those engaged in the industry. These conditions would seem to indicate the general adoption of orchard heating. At the same time it is open to query whether in all cases the average value of the crop saved would justify the total frost protection costs. It is now admitted that this will only be so when the production per acre and average price are high.

In connection with the various methods adopted for preventing damage from frosts the authors have presented us with a remarkably clear and graphic description of the conditions that govern the occurrence of frost, which, it was thought, might be of sufficient interest to many readers to justify reproduction in a somewhat abridged form.

The heat from the sun comes to the earth in the form of waves, a method of heat transfer which is known as radiation. The earth loses heat by radiation continuously, but this is felt only at night when the sun's heat is cut off.

Radiant heat passes through clear dry air without much heating of the air itself. Air is much more effectively warmed by conduction, that is to say, transfer of heat from a warm body with which it is in contact. Radiation takes place with the speed of light, while conduction is a relatively slow process.

On a calm clear day radiant heat from the sun heats the surface of the ground until it is warmer than the air in contact with it. When this occurs, heat is slowly conducted from the ground into the surface layer of air, and this becomes warmer than the air at higher elevations. Warm air expands, and consequently rises, and is replaced by cold air from above. A circulation is established in which cool upper air is progressively

brought into contact with the warm ground, heated by conduction and then forced upwards to make room for more cool air. By the end of the day the air above the earth has been to a certain extent warmed, up to heights varying, according to circumstances, from 300 to 1,000 feet. This transference of heat from one portion of a liquid or gaseous medium, such as the air, through circulation of portions of the medium, is called convection.

After sunset no heat is received from the sun to make up for that lost by radiation from the earth to the sky, and the ground soon becomes colder than the layer of air in contact with it. Heat is lost by conduction from the warm air to the colder ground in contact with it. In this way the surface layer of air soon becomes colder than the air a few feet above it. But through cooling, the air becomes relatively denser and heavier, and so tends to remain in the same place. Atmospheric cooling operates slowly and therefore does not extend to great heights, so that the temperature of the air 300 feet above the ground changes but little during the night. Thus, over a level plain on a clear calm night, there is a relatively thin layer of cold air near the ground, and an increase in temperature up to an altitude of between 300 and 800 feet. This phenomenon is known as temperature inversion and has an important bearing on the whole question of orchard heating.

If the atmosphere were uniformly cold up to great heights the air heated by the fires in the orchards would rise rapidly above the orchards without materially benefiting the trees or fruit. As a matter of fact the warmed air from the heaters rises, cooling at the same time, until it reaches the height where its temperature is the same as that of the surrounding air. It will then top and remain stationary.

The application of this principle to orchard protection provides the only practical means so far developed. As will be seen from the preceding paragraph it is not necessary to "heat all out-of-doors" in order to raise temperatures above danger point.

Various methods of adding heat to the orchard air have been suggested and have formed the basis of experiments in the past.

Water.—Spraying of trees with water has been tried as a means of adding heat to the air. The water is at a temperature considerably above freezing point and gives up heat as it cools, and in addition gives up latent heat when it freezes, thereby greatly delaying the fall of temperature below 32°F. If however the frost is severe, and the water eventually freezes, the weight of ice formed is so great as to damage severely or often even totally destroy trees. Moreover, the melting of the ice formed absorbs much heat the following day, so that relatively more heating will be required the next night if the weather remains cold.

Water in basins or running in channels liberates a like quantity of heat in freezing, and affords a small amount of protection. If a grower has plenty of water available he ought certainly to run the water both day and night during the duration of the frost, but running water is to be regarded as a partial rather than a complete protection.

Blowers.—On a night of a radiation-frost there is a marked temperature inversion, in which it is often as much as ten degrees warmer at the height of 40 ft. than at ground level. Blowers were introduced with the idea of mixing this warmer upper air with the cold air below, but failed in their object, since it is not possible to drive a current of warm air down into colder air, or at any rate to keep it down for any appreciable length of time. Moreover, the force of the mechanical currents produced was in many cases sufficient to strip the fruit and leaves from the trees. In later models attempts were made to add heat to the air, but these too were unsuccessful, because the machines were built to serve ten acres at a time, necessitating the generation of an amount of heat totally out of proportion to the practical results achieved, since by far the greater amount was lost to the upper atmosphere. It is moreover unsound to make the protection of so large an area dependent on the working of a single plant.

Orchard heaters.—Practical experience has demonstrated that the only way to obtain complete protection is to have a large number of small heat units distributed over the area to be protected. Owing to the aforementioned temperature inversion, the

layer of warm air overhead on frosty nights acts as a ceiling, which retains the heat added to the air below. By means of heaters the air below is gradually warmed until it is above the danger point. Success in orchard heating, therefore, depends on heating a large volume of air a few degrees rather than on heating a small volume to high temperatures.

The two fundamental requirements for adequate frost protection therefore are (1) a sufficient number of heaters per acre to heat a large volume of air without overheating any part, and (2) sufficient fuel to keep these heaters burning for the entire duration of the frost.

The writer goes on to describe the various types of heaters that he considers suitable for the objects in view. They consist of oil burning heaters of different patterns, and capacity, and briquet and coal burners. Oil heaters burn more steadily, require less labour for lighting, and tending and are more economical in fuel than those burning coal or briquets. On the other hand, they generally leave some trace on the fruit, either of smudge or soot, which reduces its marketable value, and their first cost is undoubtedly higher. In general it may be said that while coal or briquet heaters are particularly adaptable to small orchards (three to five acres), where the owner has plenty of help for firing, and refueling, but no facilities for handling oil heaters of the latter type are more economical for working on a large scale.

The initial costs of orchard heating apparatus of the dearest pattern, is given as approximately $290, and that of the cheapest as $105 per acre, while overhead costs vary from $42 to $14. The data for the annual cost of operations showed wide variations, due to the irregularity of frost occurrence. In a typical year the variation of working costs ranged from $40 to $1·20.

These figures indicate that even the cheapest form of scientific orchard heating is expensive, and only justifiable where the crop to be protected has a very high market value.

In India at present no such problem exists. Extensive fruit farming on a Californian scale has not yet been attempted. The seasonal range of temperatures in this country is definite and

regular for most localities. Tropical fruits can be cultivated in regions of a definitely tropical climate where no danger of a frost exists. Temperate species are protected by their late flowering and ripening against the incidence of dangerous temperatures, which even in the temperate or sub-tropical regions of India are usually confined to the winter season. It would be easy for the fruit farmer to avoid doubtful localities.

The intensity of frost is rarely sufficient to kill adult forest trees and although an unseasonable frost may kill back young coppice shoots or buds of leaf or flower, the injury is temporary, as a new set is usually formed the same season. The injury is gravest in the case of nurseries and plantations, situated in regions subject to occasional late frosts. Their protection can, however, generally be effected at a comparatively small cost. Irrigation is a powerful preventive, not only of drought but of frost, since moist soil, being a better conductor of heat than dry, draws heat from lower levels to replace that lost by radiation from the surface. Where irrigation is not installed, evening watering of the nursery is usually sufficient to maintain the soil temperature above dangerous levels. Seedlings, moreover, at the more sensitive stages are small enough to be easily protected from excessive radiation by screens or coverings, which is impracticable in the case of orchard trees.

The chief danger to be apprehended in case of forest seedlings and plants is less the actual freezing of the tissues, than their too rapid thawing in direct sunlight. Precautions are, therefore, to be taken in nurseries and plantations liable to frost, to screen the young plants on the side of the early morning sun.

EXTRACTS.

FORESTRY AT OXFORD

PAPERS AT BRITISH ASSOCIATION'S ANNUAL MEETING.

The ninety-sixth annual meeting of the British Association, which opened at Oxford on Wednesday and continues until

Wednesday next, is of special interest to timber circles by reason of the increased attention paid to forestry subjects. Indeed, in view of the existence in Oxford of an important school for that study, forestry has on this occasion a Sub-Section of its own, instead of being coupled up with botany or agriculture, or both.

The Section itself was that of botany and after the presidential address, on Thursday, by Prof. F. O. Bower, F.R.S., Dr. D. H. Campbell submitted a paper on "Some dangers of forest destruction in the Tropics." A visit was then paid to the Department of Forestry to inspect the various sections at work, the Chairman of the Forestry Sub-Section, the Rt. Hon. Lord Clinton, afterwards delivered his address, which was followed by papers by Mr. A. C. Forbes (Rathdrum, Ireland) and Mr. L. Chalk, on "Some financial points in forest economy" and "An anatomical study of some exotic timbers commonly grown in Britain" respectively.

On the resumption of the proceedings yesterday (Friday) Mr. W. E. Hiley (Editor of the *Quarterly Journal of Forestry*) gave a paper on "The financial return from Scots pine and Corsican pine," and Sir James Calder one on "Timber and some of the ways it is used."

The subject chosen by Mr. F. H. J. Jervoise, who is a considerable landowner, was "Underwood and its uses," the following being a summary of the paper:

"Divided into two classes: (1) underwood with oak standards, (2) underwood pure, mainly either ash and hazel mixed or pure, and often with a certain admixture of birch or chestnut pure, or oak pure. In many parts of the country the industry is 'dead' for varying reasons. In other parts it varies according to the degree to which it has been fostered as an adjunct to agriculture and village industries. In Sussex at the present time the utilization of chestnut underwood is a thriving industry due to the great demand for chestnut fencing. In Hampshire and other counties the utilization of hazel underwood is capable of giving employment to many men in the villages, either in the first process of 'cutting down' or in the more skilled employment of 'working

up.' The present trade in the products of the industry is quite considerable, such as crate rods, barrel hoops, etc. The wages to be earned are quite good in agricultural districts, and classes for hurdle making are distinctly popular, especially among boys. The financial aspect can be distinctly good for the same reasons that apply to other industries besides serving the additional advantage that it gives employment to agricultural labour which is not required during the winter months."

Prof. Augustine Henry (Ranelagh, Dublin) dealt with "The swamp cypresses of China and North America," and the following is a summary:

"A recent paper by Prof. A. Henry and Mrs. M. McIntyre (*Proc. R. Irish Acad.*, vol. 37, pp. 90—116) describes in great detail the swamp cypresses, *Glyptostrobus* of China and *Taxodium* of North America. These two genera were widely spread over the northern hemisphere throughout the Tertiary era, their fossil remains having been found as far north as Spitzbergen, Greenland, and Alaska. Their distribution at the present time is much restricted in area and practically confined to marshy sites, where the roots of the trees develop peculiar woody growths called 'knees,' which project above the soil and enable the roots to breathe when the ground is inundated. The Chinese species, *Glyptostrobus pensilis*, has died out in the wild state, and is known only in cultivation in two limited areas, around Canton and Foochow. Like Ginkoo, it has been preserved from extinction for superstitious reasons. The Chinese peasants plant it beside villages to bring luck to the family home, and amongst rice fields to increase the crop. The wood of both genera is valuable on account of its strength, fine grain and remarkable durability under trying conditions of moisture. The trees, when grown in swampy ground, liable to inundation by fresh water, yield a considerable volume of timber. The object of this paper is to point out the desirability of making plantations of *Taxodium* and *Glyptostrobus* in the warm temperate zone, on marshy land which has hitherto been unproductive."

Mr. R. Maclagan Gorrie, discussing the "Irrigated plantations of the Punjab." showed that recent canal developments in

the Punjab have brought huge tracts of land under cultivation, and said that as these were previously semi-desert waste, the increase in population is enormous. The economic needs of these new colonies demand a supply of wood for fuel and timber, and this is being met by the establishment of artificial forests dependent upon canal irrigation. The type of work required in these irrigated plantations is very highly specialised, and the methods now in use are the result of nearly sixty years' experiment in Changa Manga, the oldest plantation of this type. The experience gained by the Punjab foresters should be of the greatest interest to all who are connected with the canal development schemes now afoot in many of our colonies and other countries, such as U. S. A., Sudan, Australia and Mesopotamia, where the economic needs of new canal colonies will have to be faced.

Mr. Leslie S. Wood (East Grinstead) submitted a paper on "The business aspect of forestry," of which the following is a synopsis: The importance of the study of the business side of forestry. Unprofitable areas and their effect on public opinion. Principles underlying business finance and their application to forestry. Hindrance to progress due to an imperfect understanding of the financial question. Error of the compound interest theory. True expectation of profit. The necessity of stock-taking and the method of calculation. Percentage growth of timber and its relation to the current rate of interest.

This was followed by one by Col. Gerard F. T. Leather (Belford) on "Estate saw mills," and Mr. E. V. Laing dealt with "The water content of tree seedlings and transplants." Mr. Laing explained that the species selected were Norway spruce, Sitka spruce and European larch. Determinations were made for root and shoot separately and for total plant. The objects of the investigation were to observe (1) how variations in the water content occur throughout the year; (2) the period of highest water content; (3) the factors affecting water content. Considerable difficulty was experienced in finding the water content of the root on account of the adhering soil particles, but a method was devised whereby as accurate a result as possible could be obtained

by introducing the water content of the soil in the neighbourhood of the roots.

It was found that there is a period of low water content and an extended period of higher water content. The periods of high and low water contents both show fluctuations which in roots conform to fluctuations in soil water or rainfall and in shoots to temperature. Root content is high in the early part of the year in the spruces and falls as the season advances. The reverse holds with the shoot. In the larch the curves for root and shoot tend to follow each other. As regards total water content in the early part of the year, the roots hold the higher percentage, but as the season advances, the shoots hold the greater proportion. The increase in the content of shoot and plant of the spruces is later than in larch—May for the former, March for the latter. As between species total, larch has a higher water content than Sitka spruce, and Sitka spruce higher than Norway spruce. Sitka spruce further, particularly in the seedling stage, shows less total fluctuations than Norway spruce, although seedling Sitka spruce shows very great root variations.

The water content of the root is influenced by soil moisture or rainfall. High temperature and low soil moisture cause a decrease in all parts of the plant. Shading generally increases water content. Seedlings have a higher water content than transplants, and the younger the plant the higher the percentage of moisture. The older the plant the less are the variations. Frost causes a marked fall. Norway spruce was found to recover its water content more rapidly than Sitka spruce.

Dr. A. S. Watt's subject was "The ecological approach to silviculture," and that concluded Friday's proceedings of the Sub-Section.

To-day (Saturday) the arrangements were for an excursion to Lord Parmoor's beech woods in the Chiltern Hills, and on Sunday, for a joint excursion with the Botany Section to Bagley Wood.

The papers down for Monday are as follow:—

Mr. W. R. Day, "The parasitism of *armillaria mellea* in relation to conifers;" Dr. M. Wilson, "Control of *meria laricis* in

the nursery by spraying"; Mr. J. L. Waldie, "*Brunchorstia*, disease of conifers"; Mr. Thos. Thomson, "Chirk experimental area"; and Mr. Wm. Dallimore (Kew), "Roadside, street and park trees."

The Sub-Section's last day will be Tuesday, when the papers will be: Mr. C. J. Chaplin, "The application of timber testing"; Mr. S. T. C. Stillwell, "The seasoning of timber"; and Mr. Alex. Howard, "A country without trees." Finally there is to be a joint meeting with the Botany Section, when Prof. J. W. Bews will read a paper on "The ecological evolution of angiospermous woody plants."—[*Timber Trades Journal.*]

BRITISH ASSOCIATION—FORESTRY FOR PROFIT.

"Ripe Timber" Theory Criticized.

The Sub-section of Forestry considered the question of whether forestry can be a good business proposition. Mr. Leslie L. Wilson, in a paper on "The Business Aspect of Forestry," on Friday, gave an affirmative reply.

Forestry, he said, was a business just as much as stock-rearing or potato-growing. If it was undertaken by men who knew nothing about it, or who treated the woodlands primarily as game coverts or pleasure grounds, they must not expect to make a profit. But treated as a business there was no question that it was profitable and would also give both pleasure and opportunities for sport. From the earliest days inferior trees must be removed, timber must be thinned for growth, and the sale effected at the most profitable time in a tree's growth. If, for instance, a tree containing 100 feet would only grow to 103 ft. in another year it was more profitable to fell it and invest the money at 4½ per cent. than to leave the tree to produce only 3 per cent.

There was in this country a large area of woodland averaging only £25 per acre, producing about 2 per cent. per annum. If the timber were felled and sold at that price £12 10s. could be re-invested in planting young trees, and the balance could be

invested in 5 per cent. stock. There would thus be no loss of immediate income and the young trees would be growing into value at a very rapid rate. The "ripe timber" theory was a very pernicious doctrine. The price realisable for timber was phenomenally unstable, and therefore it was impossible to say just when a plantation ought to be cut. There was nothing that gave an estate a more depressing appearance than a large area of neglected woods and land out of cultivation; and planting woods would change the whole character of an estate, improve the shooting, and add to the value.

They had to remember that timber was always increasing in value at compound interest. Planting was the estate savings bank. It might be that the owner would never benefit, but he was very seldom the poorer for it and his heir was invariably the richer. Afforestation had mostly been done in the past for the pleasure of it, but there would be far more pleasure in the future when it formed part of a great national movement and when it was enhanced by a profitable return.

THE SAW MILL.

Col. G. F. T. Leathes, in a paper before the Sub-section of Forestry, advocated that a large grower of timber should become his own timber merchant by establishing a saw mill, while smaller growers might combine for a similar purpose. He had recently heard of an owner of some magnificent timber selling it at two pence per cubic foot. Such a man was an absolute child in the hands of the merchants. The ideal saw mill was one driven by water power, but a suction gas plant, if the gas were generated from sawdust or woodwaste, was very inexpensive and quite satisfactory. A steam boiler, stoked with such material, might be even cheaper than water power, as the capital outlay was less.

SOCIETY OF FORESTERS.

After the Forestry Sub-section of the British Association had concluded its session on Thursday at the Imperial Forestry Institute, a meeting of the newly-formed Society of Foresters of Great Britain was held, at which a constitution and rules were adopted and office-bearers and councillors for the current year

appointed. Full membership of the society is open only to persons resident in Great Britain who are qualified professionally in forestry. It was originally intended to have two grades of professional membership, with different rights and rates of subscription, but the meeting agreed to amend this in favour of one grade with equal privileges and subscription for all professional members. Others not so qualified may be admitted as associate members. The subscription for all above will be one guinea annually, or ten guineas for life membership. Provision was made also for admission of corporate bodies and institutions at a subscription of £2 *2s.* annually, their nominee having the same privileges as an associate member. The secretary is Mr. R. Angus Galloway, 8, Rutland-square, Edinburgh.—[*The Times.*]

LASSOING A BULL MOOSE

A Cowboy's Adventure.

One of the strangest adventures ever recorded even in the wild lands of British Columbia comes from the remote Horsefly Lake country of the Cariboo district.

Victor Furrer, a cowboy, was on his way back to his ranch from a hamlet known as Lone Butte. The trail lay many leagues through country inhabited only by big game, the most numerous of which are moose. The cowboy was following a narrow trail through jackpine thicket when, suddenly, a bull moose appeared, facing him square in the middle of the trail. There was no possibility of turning back, or out of the trail. Being unarmed, his hand instinctively went to the rawhide lariat tied to his saddle and, in a moment, he had the huge moose securely lassoed by the horns.

Then began a strange battle. The moose weighed not less than 1,500 lb.; the horse not more than 1,000 lb. The end of the lariat was bound fast to the horn of the saddle, and the latter was cinched firmly about the horse. The moose, terrified as much as the horse and his rider, crashed into the thick forest, dragging the horse and rider after him at breakneck speed, for in spite of

his huge horns, no animal is fleeter in its native forest than the moose. Small limbs of trees were snapped like matchwood in the rush and then, angered by its inability to shake itself free, the moose turned suddenly and pursued the horse and rider, who both narrowly escaped the horns as the animal plunged at them. Again the moose turned and fled from his assailants.

The cowboy, knowing that the battle would soon end in favour of the moose unless he could break free, attempted to cut the lariat with his knife, but a sudden jerk on the line shook the knife from his hand. Once again, in frenzy, the moose turned, and the rider, with great presence of mind, took a few swift turns round a bunch of jackpines entangling the huge beast so that it could do no harm.

Dismounting, he cut the rope and made it fast; then he rode to the nearest ranch-house and obtained a rifle, with which he returned and shot the moose.—[*The Times.*]

THE PLACE OF ENTOMOLOGY IN SILVICULTURE.

BY H. B. PEIRSON, FOREST ENTOMOLOGIST, AUGUSTA, MAINE.

To one who has travelled through the spruce forests of northern New England and eastern Canada and seen the appalling depredations created by insects, or who is at all acquainted with the tremendous damage which sawflies are doing to the larch and jack pine of the Lake States, or by bark beetles in the West and South, it seems wholly unnecessary to point out the very obvious place which protection from insects must take in future forest policies, and yet in spite of this widespread destruction, which, if caused by fire, would have been ample reason for a vast amount of publicity, many foresters still look upon these losses with serene indifference much as the ordinary man looks upon a spell of bad weather. It has been difficult to understand the reason for this apparent lack of interest when such tremendous enthusiasm has been shown for fire protection. It is not that insects do less damage than fire, but more probably because their

attack is less spectacular, and is often not even realised by the average woodsman until the trees have been killed.

A review of the work done in forest entomology during the last quarter century indicates that very marked changes are taking place in the attitude of the public towards forest insect control work. We have passed through the basic stage of pure research where entomological efforts have been focused primarily on systematic and morphological studies, with somewhat superficial life history work, to the stage where economic application is being made the primary goal, without, however, losing sight of the fact that all control work must be preceded by detailed life history work.

Too much emphasis cannot be placed upon the fact that the nature and amount of work done by forest entomologists depends almost entirely upon the demand for such work coming from foresters and timber land owners. The entomologist cannot go ahead, raise funds, and put into effect control measures where there is no demand, regardless how serious the devastation may be. The economic work done in the past has, in every case, been the result of demands for such work, and the results obtained have, in nearly every case, proved of decided value. The citation of a few examples will illustrate this point. The entomologist has shown that several insect pests, such as the locust borer and the two-lined chestnut borer, attack only trees whose trunks receive considerable sunlight. It is obvious that wherever planted, locust and chestnut trees should be grown in such a manner that the trunks will remain shaded, until they attain a diameter of approximately seven inches. A decided damper was put on the planting of white pine due to the ravages of the white pine weevil. An extensive study made of this insect brought out the fact that trees started at a density of 1,200 per acre on reasonably good sites will practically overcome weevil injury, due to the fact that the density of the stand causes the laterals to be forced into an upright position, one of them taking the place of the weeviled leader. Furthermore, it has been shown that pine coming up under the shade of hardwoods is almost free from weevil injury. It has been found that infestations o

the poplar or aspen borer can be practically eliminated by cutting and burning the so-called "brood trees" from which infestations spread.

Recent demand for information on the desirability of burning slash from an entomological standpoint has brought forth the results showing that the greatest menace in slash is to be found in the stumps and large limbs and not in the smaller branches which are usually the portion of the tree destroyed in slash burning. At the present time, extensive bark beetle control work is being carried on in the West, from which remarkable results are being obtained. In the East the big problem has to do with the spruce budworm. This latter work is being financed entirely by timber land owners and gives every promise of results that will preclude further wide-spread destruction. The possibilities of controlling forest insects have hardly been conceived and there remains a vast amount of work to be done, the results of which will depend very largely upon the assistance received from the foresters.

The present trend of the entomology work is decidedly encouraging in that it aims not only to control insect outbreaks, but more particularly to prevent the outbreaks. Studies are at present being made both in the East and in the West to correlate insect outbreaks with weather conditions which may very well eventually result in the predicting of possible outbreaks several years in advance. The possibility of controlling incipient outbreaks of softwood defoliators by girdling is being tried in the East. In the Lake States interesting studies are being made in connection with sawfly epidemics. In the South the prevention of insect damage to stored forest products has been receiving considerable attention.

There are two phases of the entomology work which at present deserve considerable attention. In the first place, there is a serious need of better entomology courses at our Forest Schools. Only two are at present giving adequate courses, and the lack of knowledge and appreciation of forest insect damage which many of the graduate foresters have, has been a decided handicap in the furtherance of forest entomology work. A gra-

duate forester should have some knowledge of the more important forest insects and be able to recognise their work before it assumes epidemic form. With such training, our present system of fire patrol could well be utilized to assist in locating incipient insect outbreaks. Such a system has been tried with success in Maine during the last two years. As the men become better acquainted with the nature of insect outbreaks, the results will accordingly increase in value.

The second need is the putting of trained entomologists at our forest experiment stations. This promises to be the most important and far-reaching step yet taken. The solution of forest problems in the future will depend largely on methods of management, and the advice and counsel of technical foresters will prove of utmost importance in formulating these methods. In a like manner, the entomologist can be of assistance to the forester, for planting programmes and methods of management must take into consideration the entomological side. It seems futile to advise a man to plant certain species under certain conditions, or to manage certain types by certain methods, which, from a strictly silvicultural standpoint may be perfect, but which, actually mean that the trees are doomed to be killed or seriously injured by insects. Oftentimes a slight variation in methods may be sufficient to forestall this danger. To many foresters the softwood reproduction coming in on budworm killed areas is extremely gratifying when in reality it is made up to a large extent of fir balsam which is merely inviting new outbreaks of the budworm. The extensive plea to plant white pine has been answered to such an extent in some sections that the trees are planted on even the poorest of sites and are consequently weeviled as soon as they get up above the grass. White pine is undoubtedly an excellent tree to plant under many conditions but there are limitations beyond which it is like throwing tinder on a fire. The cutting out of hardwoods to release the softwood growth has an entomological aspect which should not be ignored. The hardwoods act as a veritable insurance against loss from insects to softwoods.

Looking into the future, I firmly believe that unlimited good

will come from a closer association between men in varied lines interested in forest conservation. The problems are so tremendous and varied, and so little is actually known, it hardly seems as if we had any more than started in what is apparently the right way. However, I am firmly convinced that control of forest insects is just as practical as control of forest fires, and with the proper support the time is not far distant when the pioneer work of to-day will be superseded by the systematic prevention of future wide-spread insect depredations. The secret of successful management of our forests of the future lies not in fire protection, in disease and insect eradication, in methods of cutting or planting, but in a combination of these factors in which each is given its just consideration.—[*Journal of Forestry, Vol. 23, No. 4, April 1925.*]

WATER DIVINING IN INDIA.

The Director of Information, Bombay, writes :—

In connection with the appointment of Major Pogson as Water Diviner, the criticism has been made that before making such an appointment, Government should have investigated the possibilities of certain types of water finding machines, notably, the Mansfield and the Schmidt. In fact, these machines have been in the possession of Government for a number of years, and have been the subject of much experimental work. The results of the various trials and tests of these instruments were published some time ago in a Bulletin issued by the Agricultural Department. These machines do undoubtedly indicate the presence of any underground currents of water, but they have this disadvantage that they are unable to indicate the presence of any underground currents at a lateral distance of more than 30 feet from the instrument. Moreover, a strong current at a great depth will give similar readings to a weak current at a shallow depth. To investigate the possibility of an area of any sort entails considerable time as it is necessary to take four readings on successive mornings and evenings at different spots, and each reading lasts for half an hour. The machines can only be employed during certain hours of the day and when the sky is unclouded.

Government are, however, continuing their experiments with these machines, and in order to endeavour to ascertain the true meaning of the various oscillations of the needle which is the indicating component of the instrument, a machine has been set up on various sites first located by Major Pogson and the readings compared with the actual results obtained by excavation. It is hoped that by exhaustive collection and study of such data it may in time be possible to gain more definite indications of depth and quantity from the readings obtained.

For water divination to be of real practical use, it is essential that wells should be sunk direct on to flowing water, and the success of Major Pogson is due to his being able to locate these underground currents, and he is not restricted, as are the instruments, by the question of immobility. He has also evolved a system of calculations, based on observation and experience, which enable him roughly to approximate the depth of the currents. The extent of Major Pogson's success may be gauged from the following figures :—

In the "trap" districts of Ahmednagar, Sholapur and Bajapur, where water scarcity is most felt, 53 wells have been excavated or are in course of excavation on sites recommended by Major Pogson. Of these four have not yet reached the depth at which it was predicted water would be struck. In forty-seven cases water has been struck, while in two cases water has not yet been struck, although the depth has reached that predicted.

As regards the suggestion that the success of the Water Diviner is due to particular local knowledge, it may be mentioned that Major Pogson's work has been done in the Nilgiris, the Deccan, Central India, Gujrat Rajputana, the North-West Frontier Province and on the sea coast.—[*Capital.*]

BURMA TIMBERS.

Enterprise will secure a great Commercial Future.

During the last few years since the Burmese Government started the new policy of exporting their valuable timbers to Europe, there has been considerable progress made in the develop-

ment of the Empire, but there is still scope for greater expansion. At the annual Burma dinner here in June 1923, the late Lieutenant-Governor, Sir Reginald Craddock, made a pointed reference to the richness of Burma in its timber, and urged all who had the desire to get rich quickly to invest all the capital they had in that "Land of Promise."

It is a striking fact that while, in 1920, Britain imported timber to the value of £82,000,000, yet the meagre proportion from India and Burma only amounted to £700,000, and this was as the trade returns put it, "mostly teak." But the vast forest area of the State in Burma contains timbers the value of which is unsurpassed in any other similar area in the world. Lecturing at the Royal Society of Arts in 1923, Mr. Austen Kendall said that since "1907 the local production of resin (in India) has increased sixteen-fold. Similarly, Indian production of turpentine, leapt from 16,000 to 279,000 gallons." It is to be regretted that the same vigorous rate of advance cannot be quoted respecting timber.

Reduced Freightage.—In 1921, when the regular lines refused to ship timber except at prohibitive rates the Rhodesia was chartered at a record low rate of freightage, 70*s.* per 50 feet cube measured in the round. This ship was followed by the Clan Colquhoun, which in consideration of an increased rate of 80*s.*, collected freight both in Rangoon and Port Blair and delivered both to Rotterdam and London. This was the first instance of a direct shipment loaded in the Andaman Islands. Other charterings since were Dolworth, Baron Lovat, and Australic at steadily falling rates 65*s.*, 60*s.* and 50*s.* respectively.

Meanwhile, the demand for Indian and Burma timbers was increasing. Works executed in these woods exceeded well over one million pounds for decorative and constructive purposes in London and the provinces. When the experiment of importing teak in the round started, it was asserted that it could not be sold in this form. This has been falsified by facts, larger quantities having changed hands than ever the most sanguine had anticipated, the purchases having proved satisfactory to the buyers. There have

been cases where teak has been used where previously it would have been barred owing to price. Now that it can be had at reasonable rates, railway companies are using it again for carriage building.

Low Standard Rates.—The standard rates at which all the fine Burma hardwoods have been available during the nearly seventy years the Forest Service has been established have been on a ridiculously inadequate basis, yet in the last few years these prices have so appreciated that for many timbers they have come almost on a level with that of teak itself. Notwithstanding this satisfactory advance, however, many of these woods are obtainable at a figure which compares well with that of all other hardwoods used for similar purposes.

For years past there has been a regular and continuous export of satinwood from Ceylon to all parts of the world. In America it realises the very best prices for the finest decorative work, for its great beauty of colour and figure is universally known and appreciated. But one individual log of Burma padauk reached London that certainly equalled if it did not excel in colour, figure and texture, the finest satinwood ever yielded by Ceylon forests. The two woods are very like each other, though the padauk is a rich red colour, which soon tones down with exposure to a beautiful golden-rose shade. This particular tree realised for the Burma Government Rs. 1,600 per ton as it lay in the forest. As the rupee fluctuates with the value of silver, the maximum and minimum equivalents in British currency are £200 and £110 respectively.

Need for Inland Transport.—Only a fraction of the vast forest wealth has been available up to date, for extensive areas remain almost undisturbed, representing large capital locked up and not only lying idle, but even deteriorating. Larger quantities could have been exported had there been better inland transport facilities and means for the conversion of the extracted timber. In these respects Burma is far behind. The revenue obtainable from the forests by the State is closely inter-related with these matters and the whole question is likely to become one of urgent and

critical consideration soon. In the majority of other countries the realisation of their timbers has been a vitally important matter, and, indeed, of primary importance to the very existence of the State. It is very different in Burma and until now the necessity has never arisen. More roads want making, railways extended and even ships bought if a successful trade is to be generated. Rangoon, ranking thirty-second in trade volume among the world's ports, is capable of much wider expansion, which would be facilitated were it free and open to all. Development on such lines would result in an organisation which would ensure regular and consistent supplies, for it is of little avail to seek for and develop new markets if supplies, adequate in quality and quantity are not forthcoming.

Exploitation Required.—State initiation and exploitation would bring these products extended use. For years the Government has tried to encourage private enterprise to exploit the lesser-known native timbers with little success, the problem being too intricate and hazardous. In countries where private enterprise has been most successful in forest industry, there has been unlimited freedom and independence of action throughout the industry. But the Burma forests are State property, and the State is pledged to manage them with the object, not only of maintaining them in their existing condition, but of improving them to the greatest possible extent in the interests of posterity. So, as unlimited freedom of action for private enterprise is impossible, new laws should be introduced to make it possible for the good of Burma and the world's timber trade.—John M. Fite, in the *Illustrated Carpenter & Builder.*—[*Reprinted from The Timber News.*]

FOREST CONFERENCE AT RANCHI.

Mr. E. L. Hammond, I.C.S., in opening the Forest Conference at Ranchi, the first of its kind in the Province of Bihar and Orissa, made a lengthy speech encouraging investment in Forestry. The gazetted Forest Officers and Mr. W. H. Lewis, I.C.S., Revenue Secretary to the Government of Bihar and Orissa, were present.

"Forestry is a good investment" said Mr. Hammond, "whether for the Government or for the landlord. You are the active agents of the bank. Your directors are laymen, and it is up to you to show by the results of your work that the department is, as I believe it is, worthy of all encouragement, and that money for further development or for the acquisition of suitable areas is money well spent.

Mr. J. W. Nicholson, I.F.S., read a paper on the possible economical developments for the better utilisation of the Government forests of the Province.

Mr. Gibson thanked Mr. Hammond for his presence in the first session of the conference and for the discussion of certain technical papers. Among the subjects discussed were the silvicultural treatment of sal forests, standard design for forest buildings, revision of shooting rules, protection of game, bamboo forests and their utilisation and preservation, transit rules for timber in transit by road and by water, uniforms of Forest Department subordinates, and, recruitment of forest labour and its management.—[*The Pioneer.*]